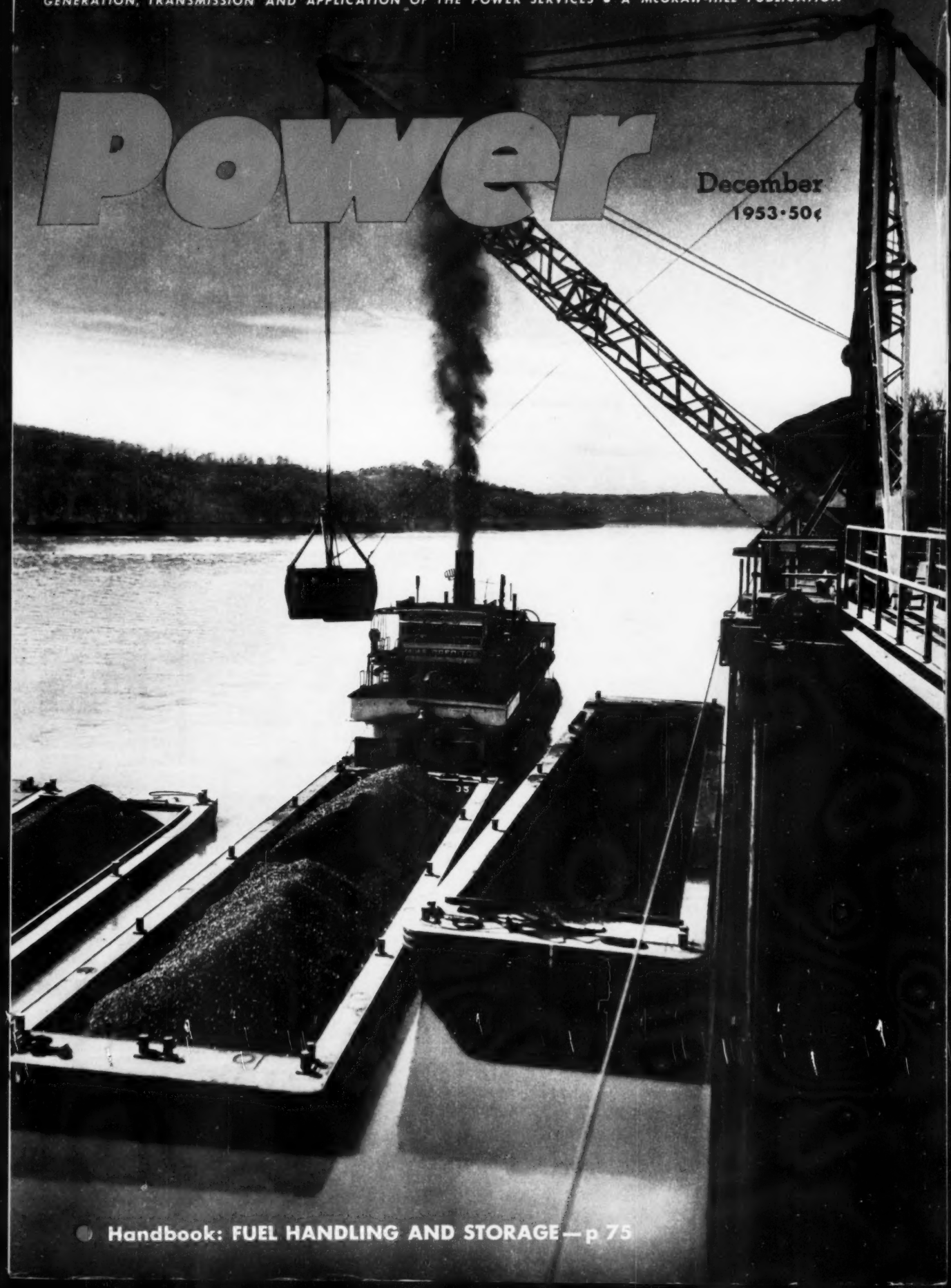
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

December
1953·50¢



Handbook: FUEL HANDLING AND STORAGE—p 75

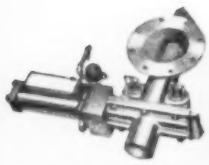
Can your ash & dust removal be improved?

Unless your plant is now enjoying the benefits of A-S-H engineering and equipment, the chances are that our pioneering experience can be of inestimable value to you.

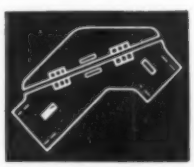
In thirty years of specialized cooperation with power engineers, we have streamlined systems to fit individual needs and developed new equipment to make them pay off in increased efficiency and lowered costs of maintenance and operation. Thousands of dollars have been saved.

Send your problem to us for analysis, and learn, without obligation, what we suggest to improve your ash and/or dust disposal. Write us today.

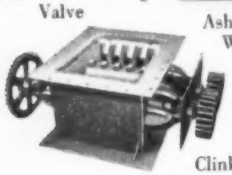
A few accessories to A-S-H engineering effectiveness:



Materials-handling Valve

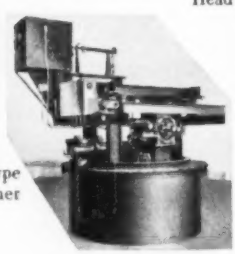


Ashcolite Pipe & Wearback Fitting



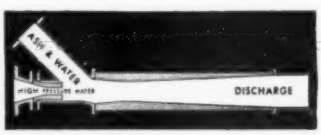
Clinker Grinder

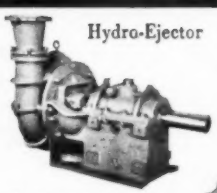
Batch Type Dust Conditioner



Automatic Sequence Head

Hydrovactor





Hydro-Ejector

Hydroseal Ash Pump

De-hydrating Hydro-bin

Continuous Vacuum Collector

THE ALLEN-SHERMAN-HOFF CO.

Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.

Offices and Representatives in Principal Cities

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materials handling systems

This power plant uses Link-Belt self-propelled trippers to discharge coal to bunkers from twin Link-Belt 36-in. wide belt conveyor systems, each handling 450 TPH.

TOTAL ENGINEERING

It's LINK-BELT's answer for improved belt conveyor performance

BELT conveyor efficiency begins with correct analysis of overall system requirements. And right from the start Link-Belt offers you unique advantages. Our engineers can apply broad experience to your bulk handling problems.

Working with a complete line of quality components, they can select the belt conveyor equipment best suited to your exact needs. What's more, Link-Belt has a nation-wide engineering organization that will follow through on every detail. This includes supplying all related equipment . . . building supporting structures and enclosures . . . erecting the complete job, if desired.

It's easy to see why "total engineering" results in top belt conveyor performance. For complete information, call the Link-Belt office near you today.

15,131-B

LINK-BELT

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LINK-BELT builds a complete line of belt conveyor components

ALL TYPES OF ROLLER BEARING IDLERS

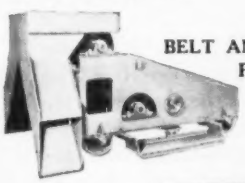
Impact-cushioning idler

45° troughed idler

Belt-training idler

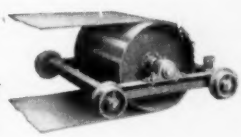
20° troughed idler

Return idler



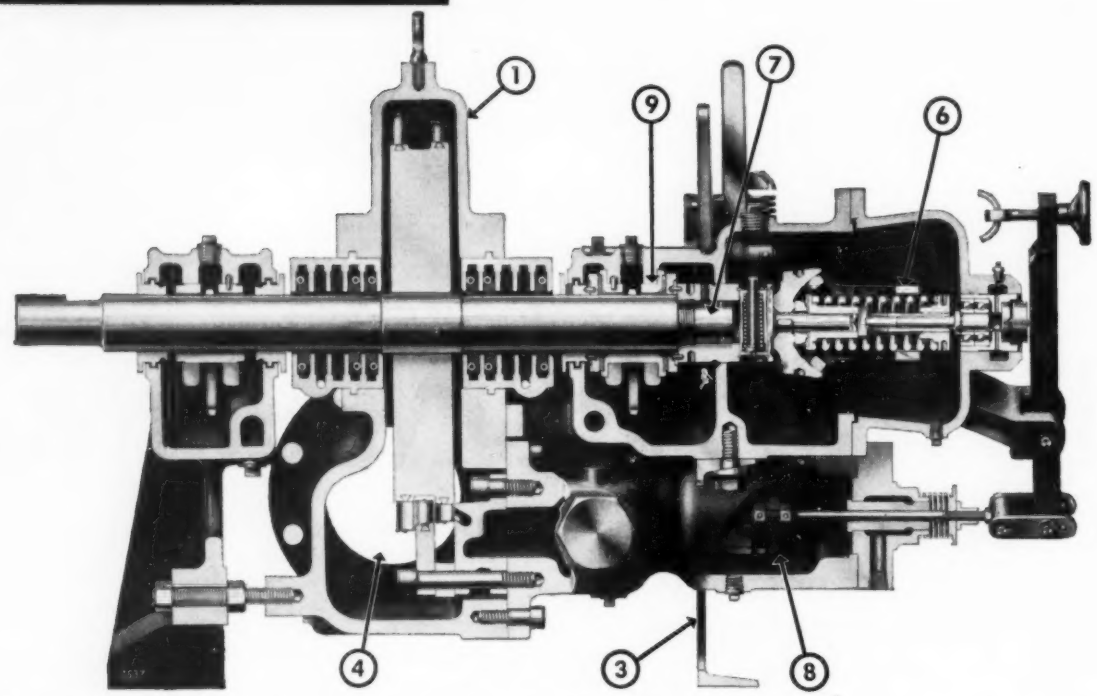
BELT AND MOTOR PROPELLED TRIPPERS

COMPLETE TERMINAL MACHINERY



NEW DE LAVAL HCB SINGLE STAGE TURBINE

can be ordered from stock



1 Case and Cover Split Horizontally on centerline for ease of maintenance.

2 True Centerline Casing Support assures distortion-free radial expansion. *Not shown.*

3 Flexible Support at governor end provides for axial expansion.

4 Exhaust Opening either right or left side for installation flexibility.

5 Steam Strainer, protecting trip and governor valves, is *removable* for cleaning without breaking steam connections. *Not shown.*

6 Constant Speed Governor features governor weights pivoted around frictionless surfaces.

7 Complete Governor Assembly is now *replaceable as a unit.*

8 Balanced Single Seated Main Governor Valve has proportional flow characteristics for sensitive, positive control.

9 Shaft Locating Bearing of adjustable double collar type.

Horsepower: 100 MAX
Steam Pressure: 300 PSIG MAX
Steam Temperature: 550F MAX
Exhaust Pressure: 25 PSIG MAX
Speed: 4,000 RPM MAX
Steam Inlet: 2″–250# ASA FLG.
Exhaust: 6″–150# ASA FLG.
Weight: 1,200 LB

Here's the new De Laval HCB Single Stage Turbine which is now "on the shelf" . . . ready for immediate shipment. This mechanical drive turbine is simple, rugged, designed for long economical life and low maintenance. For example, note the true centerline casing support, the replaceable governor, the removable steam strainer. Investigate all the advantages of this versatile driver. It is ready to handle—*at low cost*—a variety of applications in your plant.

Send for new Bulletin 4206
which gives vital facts and figures

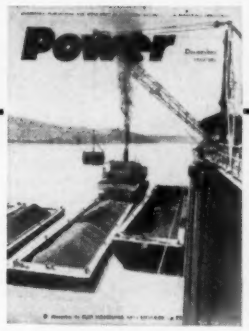
DE LAVAL *Mechanical Drive Turbines*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

DL808

Power

DECEMBER 1953 • VOLUME 97 NUMBER 12



THE COAL-UNLOADING DOCK may do double duty in industrial plants like the Marietta, Ohio plant of Electrometallurgical Co. Their 2-ton crane, shown on our cover, handles ores as well as coal. Coal arrives by rail and barge to fire four 650,000-lb-per-hr steam generators, supplying four 40,000-kw steam turbines and considerable process steam.

This plant, world's largest alloys maker, uses a conveyor-belt system to move about 40 carloads of coal a day to the boiler furnaces, and to the outdoor-storage area, which holds a four months' supply.

In your plant, as in this big new one, fuel handling is an important cost factor, but modern methods can keep it in line. For ideas on improving your setup, see our handbook on handling and storage, p 75.

ENGINEERING AND MANAGEMENT

FUEL HANDLING AND STORAGE: Special 24-page section 75

The coal-handling job 76
Receiving, unloading coal 78
Outdoor coal storage 82
Covered storage 86
Conveying equipment 88
Final handling, weighing 92
Fuel-oil systems 94
Handling gas fuel 97

Packaged watertube boiler treatment 99
Facts to consider about gear failures 102
Utility performance shows improvement 104
Guilty or not? . . . Smoke inspector's headache 106
Data Sheet: Condensate velocity fixes pipe size 107

PLANT OPERATION AND MAINTENANCE

Modern homelike plant goes all out for employe conveniences 111
Know how to use the right fire extinguisher 114
Don't murder your feedwater regulator 116
We had to make these diesel engine repairs 118
Are you pinning down causes for rolling-contact bearing failures? 120
Treat your compressor shaft seals right 122
Save money! Rent an air compressor 123
Get acquainted with diaphragm pumps for industrial jobs 124
How to build easy maintenance into your new heating plant 126
Freight elevators modernized at one-third cost of new units 128
Practical ideas: Trading post for operating, maintenance shortcuts 130

Plant problems 136
How-to 142
Headwork 144
Marmaduke Surfaceblow 146

READER SERVICE SECTION

Speaking of power 150
Power news 152
Technical briefs 154
Plant-equipment news 158
New free bulletins 167
George Edwards 170

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

Next month . . .

■ Potential savings promised by superpressure steam plants have set many engineering designers to studying the problems involved. In January, Igor J Karassik, well-known pump designer, tells you in the first of a 2-part article what the pump brain teasers are and how they can be solved.

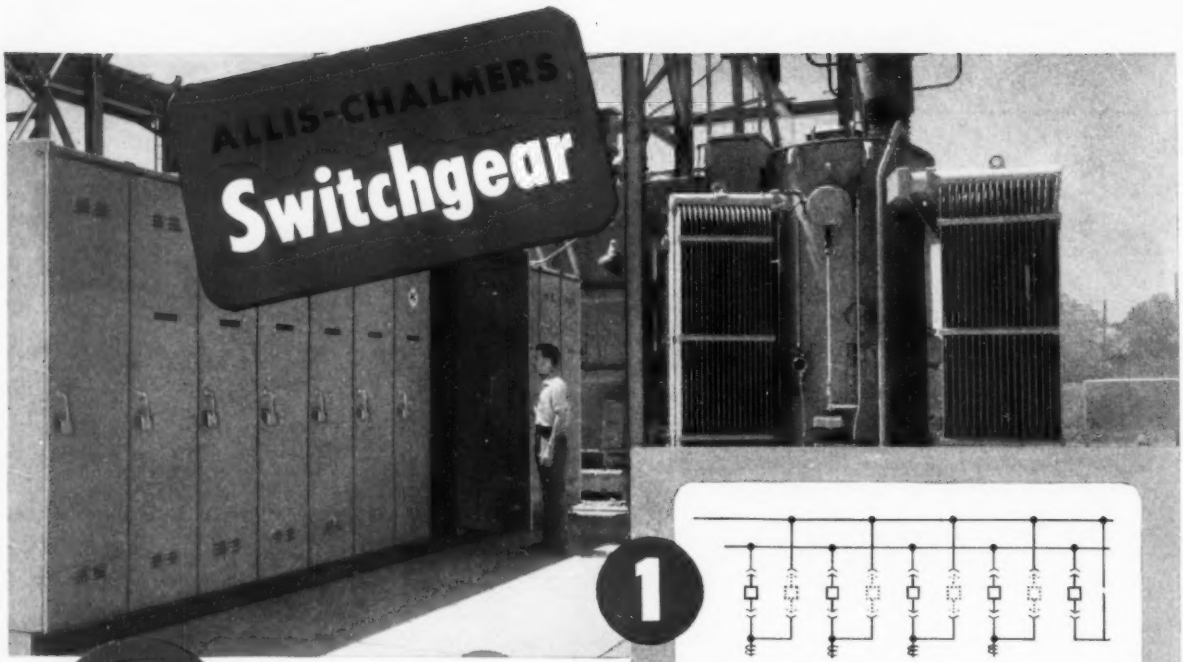
■ Are you faced with servicing a new research laboratory? G A Hanlon reports on the first year's operation of the power services for a new instrument test laboratory. There will be ideas here of value for your new plant.

■ The downwash of gases from plant stacks can be controlled by proper engineering. Prof R H Sherlock tells how to analyze surroundings, load, wind conditions, to get best chimney height; make your plant a good neighbor.

■ Running electrical cables through hot, cramped places has caused sleepless nights for many a power engineer. Read about mineral-insulated cables that can stand the gaff, need little room.

. . . and future months

■ Coming up in March is a special report by Steve Elonka on sheet gaskets, their materials, preparation, installation. Learn about available materials and how to choose the one suitable for solving your problems.



4 WAYS to Guard Against Power Interruption

Here are a few of the many different circuit arrangements Allis-Chalmers can provide. All are designed to assure continuity of service. Each one is specially suited for specific situations.

With Allis-Chalmers switchgear, all these circuit schemes have one advantage in common. Each arrangement shown can be built into standard units of Allis-Chalmers metal-clad switchgear without adding extra cubicles. This economy and simplicity, plus the obvious space savings, make Allis-Chalmers equipment especially attractive.

Which Arrangement is Best? A study of your problem is needed to answer this question. Any one of these arrangements may be best for your plant. Or maybe an entirely different scheme is needed. In any case, Allis-Chalmers engineers can help you work out the best scheme for you . . . one that provides ✓ economy, ✓ simplicity, ✓ space saving, and ✓ uninterrupted service.

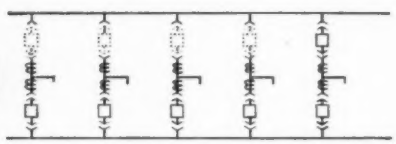
For complete information, call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4165

1

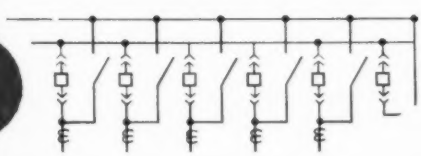
DOUBLE BUS in line

2



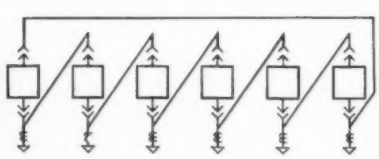
DOUBLE BUS back-to-back

3



TRANSFER BUS and disconnect

4



RING BUS

ALLIS-CHALMERS

Power

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...with Power readers...

THERE'S NOTHING NEW . . .

about operating steam boilers at or over the critical pressure. DeLaval, a Swedish engineer, did this over 50 years ago.

The Scientific American Supplement No. 1143 carried an article about this project on Nov 27, 1897. The electric lighting of the Universal Exposition at Stockholm was supplied from six units, four of 100-hp capacity and two of 50-hp. Each unit consisted of a boiler, turbine, dynamo, condenser, feed pump, and water- and steam-pressure regulators. The turbines and once-through boilers were designed to operate at 2850-psia working pressure, but were logged as high as 3420 psia. The boilers had been tested at 5700 psia. They operated from spring to fall of the year 1897.

In 1930, the DeLaval Steam Turbine Co printed a booklet called, *A Pioneer in High Pressure Steam*, which described the operation in detail.

St. Paul, Minn. — R BIZZELL

Thanks, reader Bizzell, for your leads on this early work with critical pressure steam. The information illustrates once more the scarcity of really new ideas. But let's not lose sight of the fact that the idea is not always enough. As much or more ingenuity often goes into making that idea a working reality. Today there are no working critical-pressure plants.—ED.

...lines and bylines

Witman, *left*, and Miller talk over operating plans for new turbine unit

GOOD PLACE TO WORK is Steve Elonka's opinion of the new Titus Station of Metropolitan Edison Co in Reading, Pa., p 111. Steve found here a grass roots demonstration that it takes more than modern equipment to make a plant inviting.

Big reason for the congenial atmosphere at Titus starts with John G Miller, superintendent of production, and John F Witman, station superintendent. Let's take a quick look at the backgrounds of these two topnotch morale builders:

John Miller, a native of Ewardsport, Ind. graduated from Purdue University with BS and MS degrees in engineering. He worked for the Detroit Edison Co before enlisting in the U.S. Navy at the start of World War II. After working four years in the design branch of the Bureau of Ships as a Lieutenant Commander, Miller joined Gilbert Associates, Inc as a mechanical engineer. He came to Metropolitan Edison Co in 1948. He is a member of the American Society of Mechanical Engineers, American Society of Naval Engineers and the Pennsylvania Society of Professional Engineers.

John Witman advanced to his present position through attention to details, hard work and a willingness to study on his own time. Shortly after graduating from Reading High School he joined MECO as a power-plant oiler. After holding jobs in all phases of plant operation he was made superintendent of the West Reading plant in 1941. When construction of Titus started in 1949, Witman was named superintendent. Throughout erection he served as the company's contact with the engineering and contracting firms.

LAST DUTY FOR *POWER* was performed by Joe McCabe in writing the Handbook on Fuel Handling and Storage, p 75. By the time you read this he will be taking over the reins as editor of our contemporary *Combustion*.

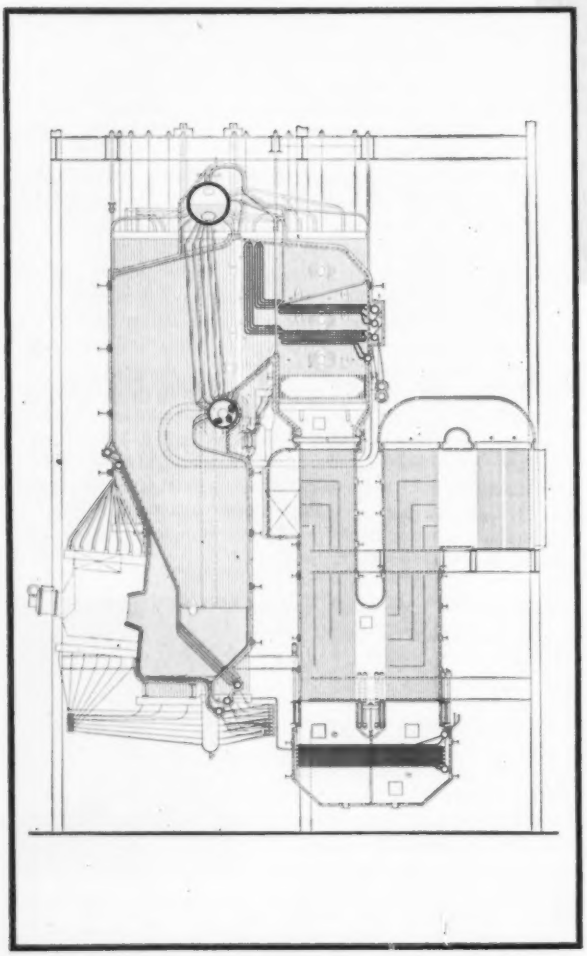
Joseph C McCabe

Joe has fitted himself well for his new duties. In his eight years as Associate Editor on POWER he closely followed the developments in fuels, firing, steam generation, feedwater treatment, air and stream pollution and other related topics. His long experience in the operation and maintenance of power plants and other utility departments stood him in good stead in the many articles he prepared for POWER.

Joe's driving energy has carried him into many activities, including professional societies, his local school board, the Little League and other civic projects. We of the editorial staff will surely miss him, with his ready smile and cheerful comebacks. We know you who followed his work join us and his many friends in wishing him the best of everything for a long, successful career.

More B&W Pressurized Cyclone Furnace Boilers on

LARGE CHEMICAL

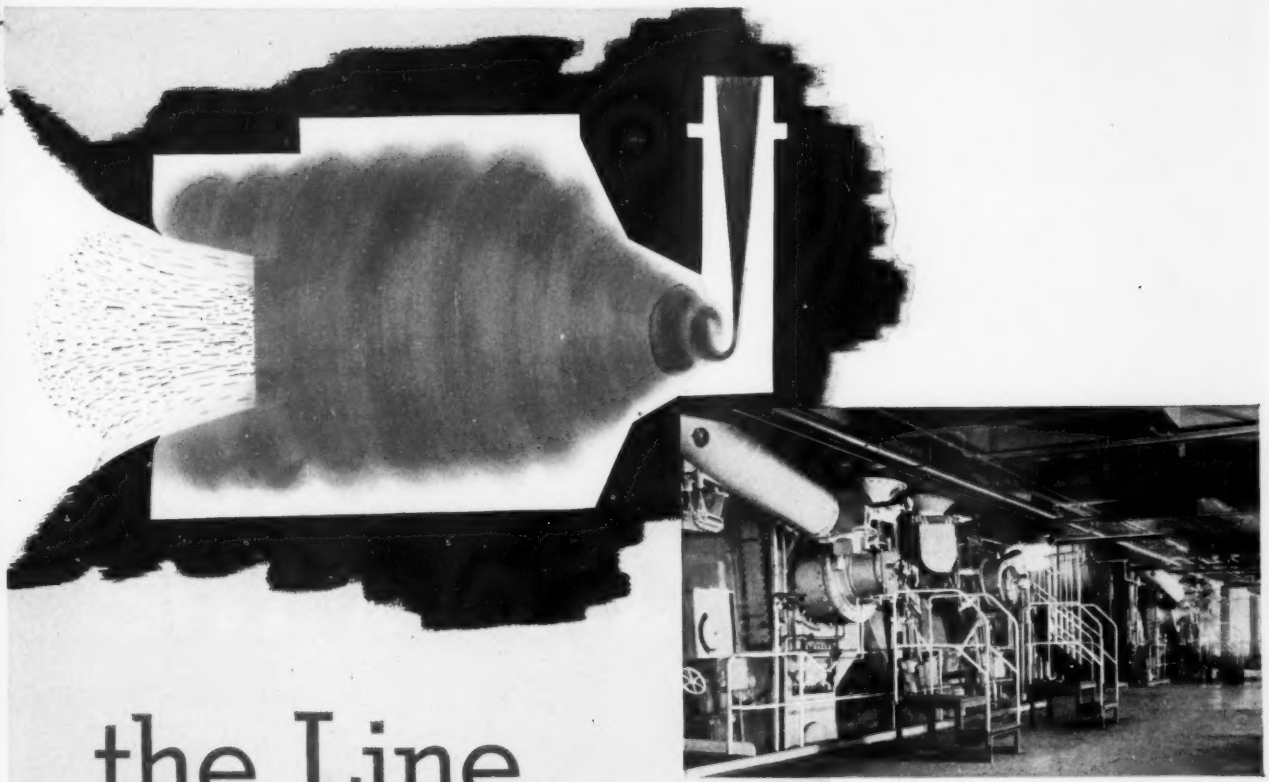


B&W Cyclone-Fired Radiant Boiler for a leading chemical manufacturer. Four units of this design are installed in one power plant. A similar unit is in operation at another of the company's plants. Each boiler normally generates 400,000 pounds of steam per hour with superheater outlet conditions of 1250 psi, 830 F. The design pressure is 1400 psi.

Having pioneered Cyclone Furnace firing for industrial steam plants, a large chemical manufacturer has recently placed its fourth and fifth Cyclone-fired boilers into operation. The first pressurized Cyclone-fired boiler ever built has been in successful continuous operation at one of this company's plants since February 1949.

ELIMINATION OF FLY ASH PROBLEM

Low fly-ash discharge to the stack, without the use of precipitators, was a prime consideration in the original selection of Cyclone Furnaces for the first three units back in 1946. Most of the coal-ash is converted to liquid slag which is removed through the slag tank, and can be disposed of readily. Thus, some of the most difficult problems in power-plant operation — preventing heavy stack discharge and eliminating the handling of large amounts of useless fly ash—are overcome. But, in addition to solving these problems, a whole host of other benefits have also been real-



the Line

Firing aisle showing Cyclone Furnaces.

PLANT INSTALLS 4TH and 5TH CYCLONE UNITS

ized, and Cyclone Furnaces were thus the logical choice for the firm's two new units.

SIMPLIFICATION OF COAL BURNING EQUIPMENT

Simplification of the entire process of supplying and burning the coal is an important asset of Cyclone Furnace firing. It reduces maintenance costs, makes operation easier, and improves availability. This is because pulverizers, with their drives, fans, ducts, and burners are not needed, since the Cyclone Furnace uses coal which is merely crushed, instead of pulverized. This also increases safety and lends itself readily to "push-button" operation.

GREATER FUEL EFFICIENCY — WIDE COAL RANGE

Greater firing efficiency results from the great turbulence and high temperatures in the Cyclone Furnace. Carbon loss is practically eliminated. In addition, excess combustion air is reduced, bringing a corresponding reduction in heat lost to the stack.

A wide range of coals is burned in the Cyclones. Piney Fork coal is the designed fuel for this plant, but coals of many different varieties have been burned successfully.

PRESSURE-FIRING — NO INDUCED DRAFT FAN

Pressure-firing without induced draft fans is another pioneering achievement of this chemical company in its five Cyclone-fired units. Since the first boiler was placed on the line nearly five years ago, pressure-firing has contributed to smoother operation with reduction in fuel consumption. Having only forced draft fans on the unit eases the operator's tasks, simplifies controls, and saves considerable auxiliary power.

B&W's experience with Cyclone Furnaces, Pressure Firing, and so many other cost-saving engineering advances, is at your disposal when your next plant is being designed.

The Babcock & Wilcox Co., 161 East 42nd St., New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

G-618

FROM 1 HP. UP...

Elliott covers the

Looking for integral horsepower motors?

You will find the motor you need in the extensive Elliott Crocker-Wheeler line. Elliott motors combine the substantial quality of famous name reputation with the equally valuable factor of Elliott progressive engineering development. A typical group of these motors is illustrated here, including the widely used Elliott C-W totally-enclosed fan-cooled motor, available in both standard and explosion-proof enclosures; the new Elliott C-W gearmotor, and the dependable, compact Elliott C-W brake, available with any Elliott C-W motor.

Get complete technical data on these or other motors in this line by contacting your local Elliott representative or writing Elliott Company, Crocker-Wheeler Division, Ampere, New Jersey.

ELLIOTT

CROCKER-WHEELER DIVISION

Checking on big motors?

Look over the Elliott achievements of recent years in big motors — the soundly established advantages of Elliott Fabri-Steel construction — strong, rigid and above all, adaptable... the facility with which a standard motor can without change in electrical design be provided with any type of enclosure, including the now famous Elliott Outdoor Splashproof (weather-protected) motor... the excellent workmanship including long-life mica-wrapped coils, with insulation engineered to the need, and careful end-turn lashing and bracing. Your local Elliott engineer will give you details on these motors, or write Elliott Company, Ridgway Division, Ridgway, Pa.

Company

RIDGWAY DIVISION

SEE OUR EXHIBIT
At The Chemical Industries Exposition
Philadelphia, Pa., Nov. 30--Dec. 5

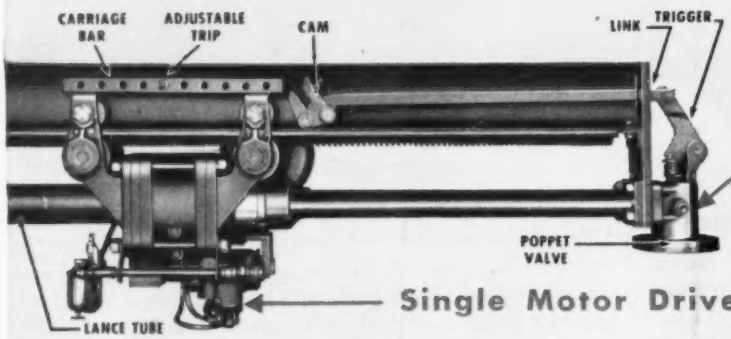
Elliott FABRI-STEEL MOTORS AND GENERATORS

Q3-2

ONLY DIAMOND Model IK BLOWERS GIVE YOU THESE THREE

The Diamond Model IK Long Travel Retracting Blower does an efficient job of cleaning tube banks of all kinds. It is particularly suited to locations where gas temperatures are too high for permanently installed multi-nozzle blower elements. It cleans by action of powerful jets from the end of a traveling and rotating lance tube. The close, helical blowing pattern (a sweep every inch) thoroughly cleans soot, dust, and most slag deposits over a wide radius.

The three features described here are all vital to the economy and dependability of any long retracting blower. ONLY Diamond Model IK gives you these THREE.



Single Motor Drive

A single motor simultaneously propels the carriage and rotates the lance tube through a rugged system of gears. This represents the ultimate in simplicity . . . the last word in reliability. There is only ONE set of motor elements, ONE set of control elements and ONE set of connections to power supply. Motor can be air or electric.

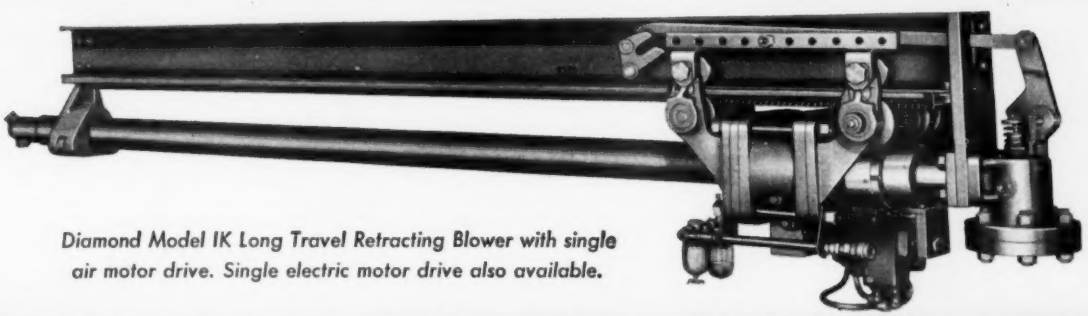
Mechanically Operated Valve

Control of the air or steam used as the blowing medium is automatic, positive and accurate in Model IK by means of a simple mechanically operated valve. As the carriage begins to move the lance tube into the boiler, an adjustable trip on the carriage bar engages a cam which opens the valve through a linkage. As retraction of the lance nears completion, the trip reverses the cam, closing the valve. All pilot or diaphragm valve elements are eliminated. Adjustable trip can be moved left or right to open valve earlier or later.

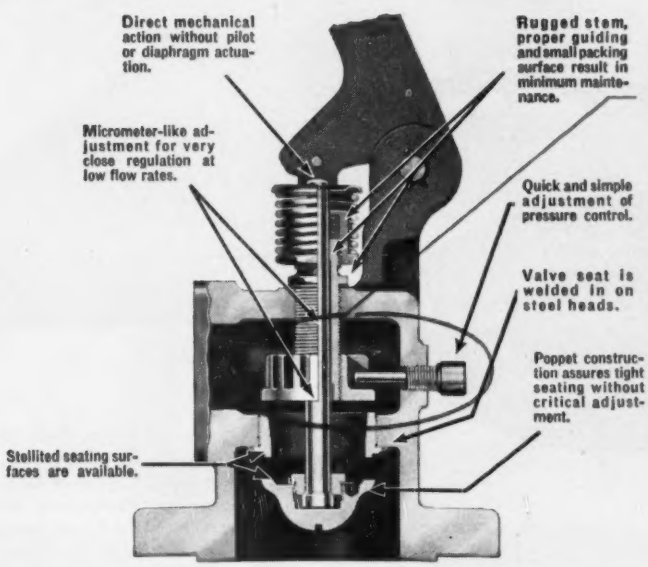
50th ANNIVERSARY 1903-1953

DIAMOND POWER SPECIALTY

SINGLE MOTOR DRIVE
MECHANICALLY OPERATED VALVE
ADJUSTABLE PRESSURE CONTROL



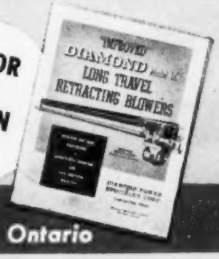
Diamond Model IK Long Travel Retracting Blower with single air motor drive. Single electric motor drive also available.


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Stellited seating surfaces are available.
Rugged stem, proper guiding and small packing surface result in minimum maintenance.
Quick and simple adjustment of pressure control.
Valve seat is welded in on steel heads.
Poppet construction assures tight seating without critical adjustment.

Adjustable Pressure Control in Poppet Type Valve

Easily and quickly adjusted, the control consists of a ribbed disc carried on the threaded valve stem guide. Its location outside the path of valve travel prevents interference with full and immediate opening of the poppet valve . . . avoiding wire drawing. Throttling is at the back seat so that the main seat is spared the damaging action of this duty. No orifice is required in the line. This feature provides the means for greatest blowing economy for each individual blower.

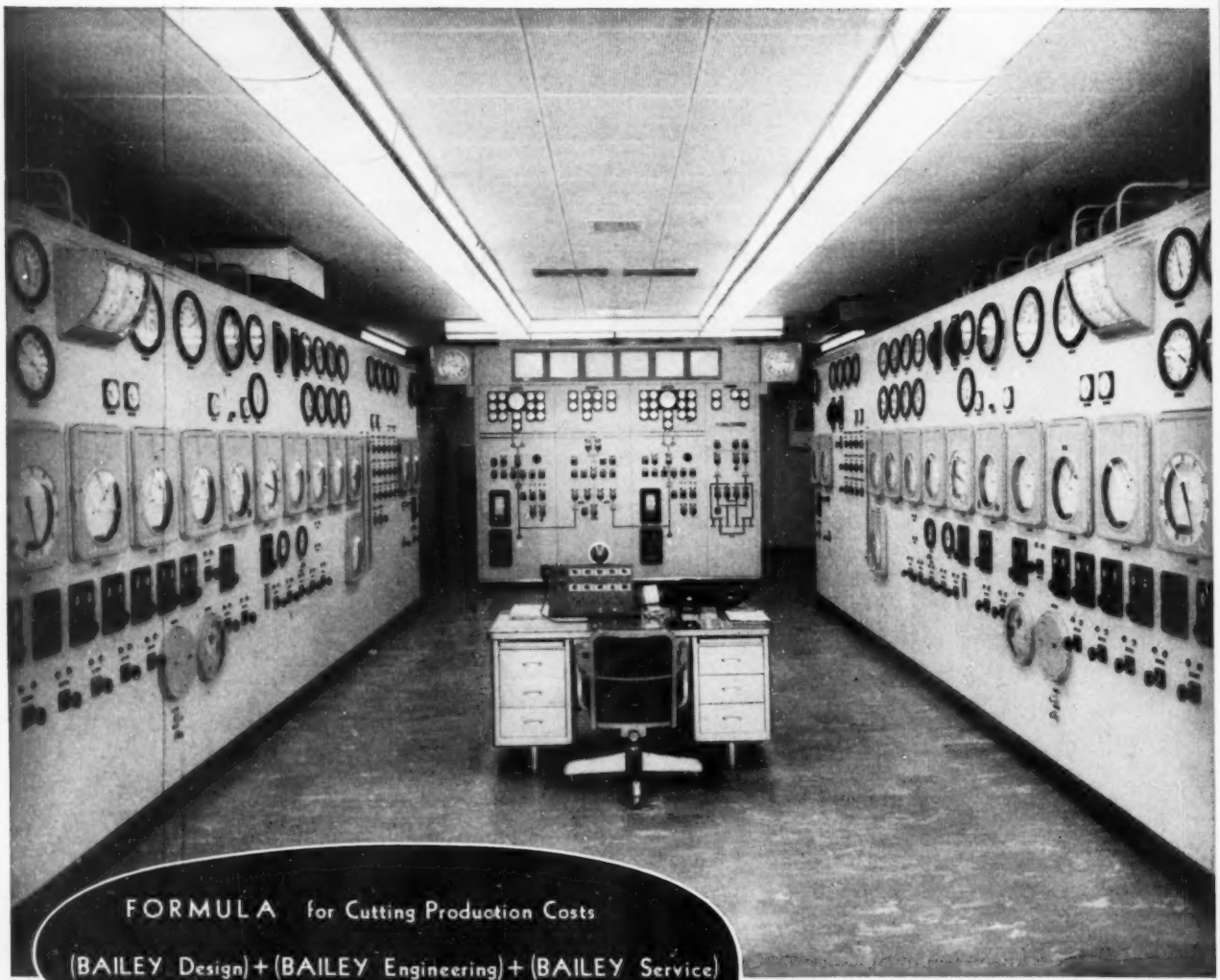
ASK FOR NEW BULLETIN 1080U



CORPORATION LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario

How to Control



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

Control Room at Highgrove Power Plant of California Electric Power Co., Riverside, Calif. In this "outdoor" plant Bailey Control of Combustion, Feed Water, Steam Temperature, Air Heater Temperature, and Fuel Oil Temperature, assists operators in producing low cost steam.

Units 1 & 2 are each rated at 320,000 lb per hr capacity, 850 psi, 900F. They may be fired with gas or oil.

Steam Cost

★ Close regulation of fuel and air input is vital to a strict control of your steam cost. But that's not all. You'll need control of other factors too. Your power costs can be held down only by controlling all of the important operations in your steam plant. That's where you can be sure of help from Bailey Controls. Here's why they can do the job and do it right:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, as might be the case if he had only a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

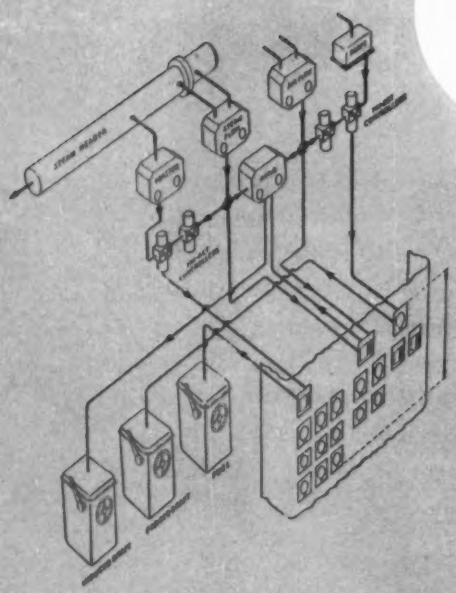
Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For close control of steam cost, more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-118-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS



COPES VULCAN offers

COMBUSTION CONTROL

You can save fuel, labor and maintenance dollars by installing modern Copes-Vulcan combustion control.

You can be sure of:

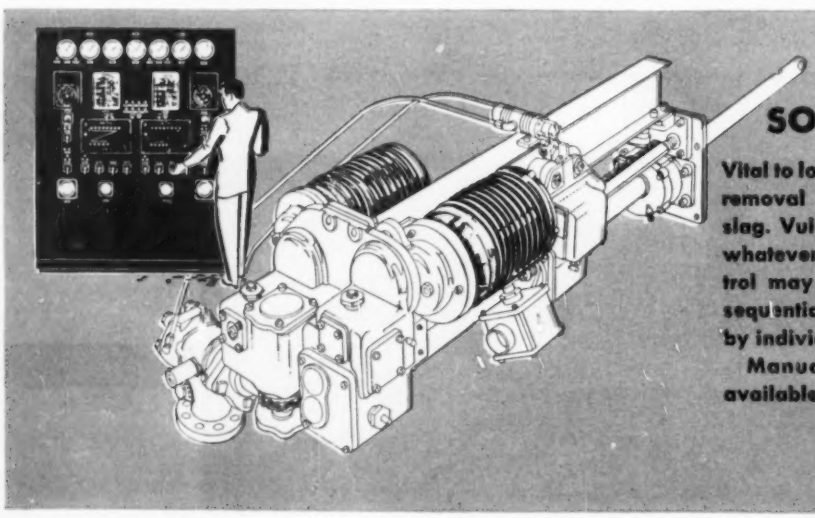
—highest combustion efficiency
—constant furnace pressure
—constant steam pressure and temperature

***Bulletin 1007-A* describes this new approach to boiler control through**

C·V+T=BBC

COPES+VULCAN+Taylor=BETTER BOILER CONTROL

Reduce your steam costs. Get more efficient and safer boiler operation. Use one or more of these four Copes-Vulcan aids to offset rising costs of fuel, labor and maintenance. C • V + T offers a new approach to boiler control—with undivided responsibility from analysis to installation—and service wherever needed for the life of the installation.



SOOT BLOWING

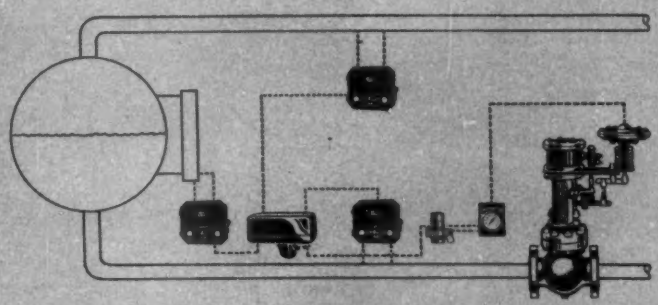
Vital to lower steam costs is the regular removal of soot, sintered dust and slag. Vulcan does this job effectively, whatever the size of your boiler. Control may be automatic or automatic-sequential—through central panel or by individual push buttons.

Manually-operated blowers are available. *Write for Bulletin 1001.*

4 aids to lower steam costs

FEED WATER CONTROL

Copes feeds exactly as needed to maintain correct water level while meeting steam demands. Three-, two- or one-influence systems are available for your specific needs. Control may be independent, or tied in with combustion control. Take a look at the newest three-influence COPES instrument-type feed water control system—Type 3-L, described in *Bulletin 1013.*

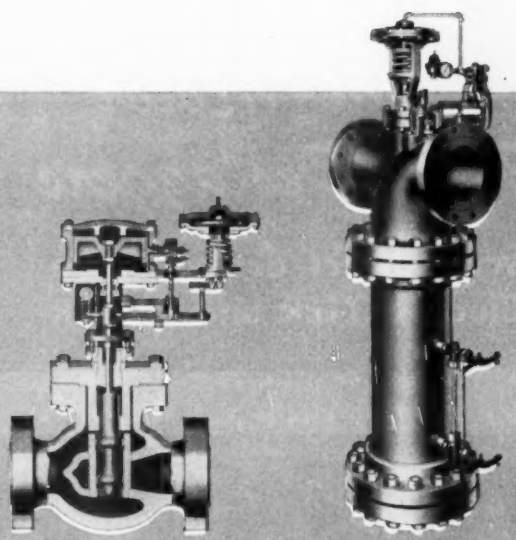


COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

REDUCING and DESUPERHEATING

Copes Reducing Valves have ports characterized for specified flow and pressure conditions. Rugged construction throughout. *Write for Bulletin 477-A.*

Copes Desuperheaters are self-contained, need no "extras" for installation. Temperature control is accurate, even on lightest flows, because cooling water is fully controlled inside the chamber. *Bulletin 405-C.*



How to STOP

ROTATING MOTOR rotates the swivel tube S-L-O-W to clean thoroughly—adjustable speed.
TRAVERSING MOTOR extends and retracts the swivel tube—FAST to save time—to escape high temperatures.

VULCAN
Dual-Motor Wall Deslaggers

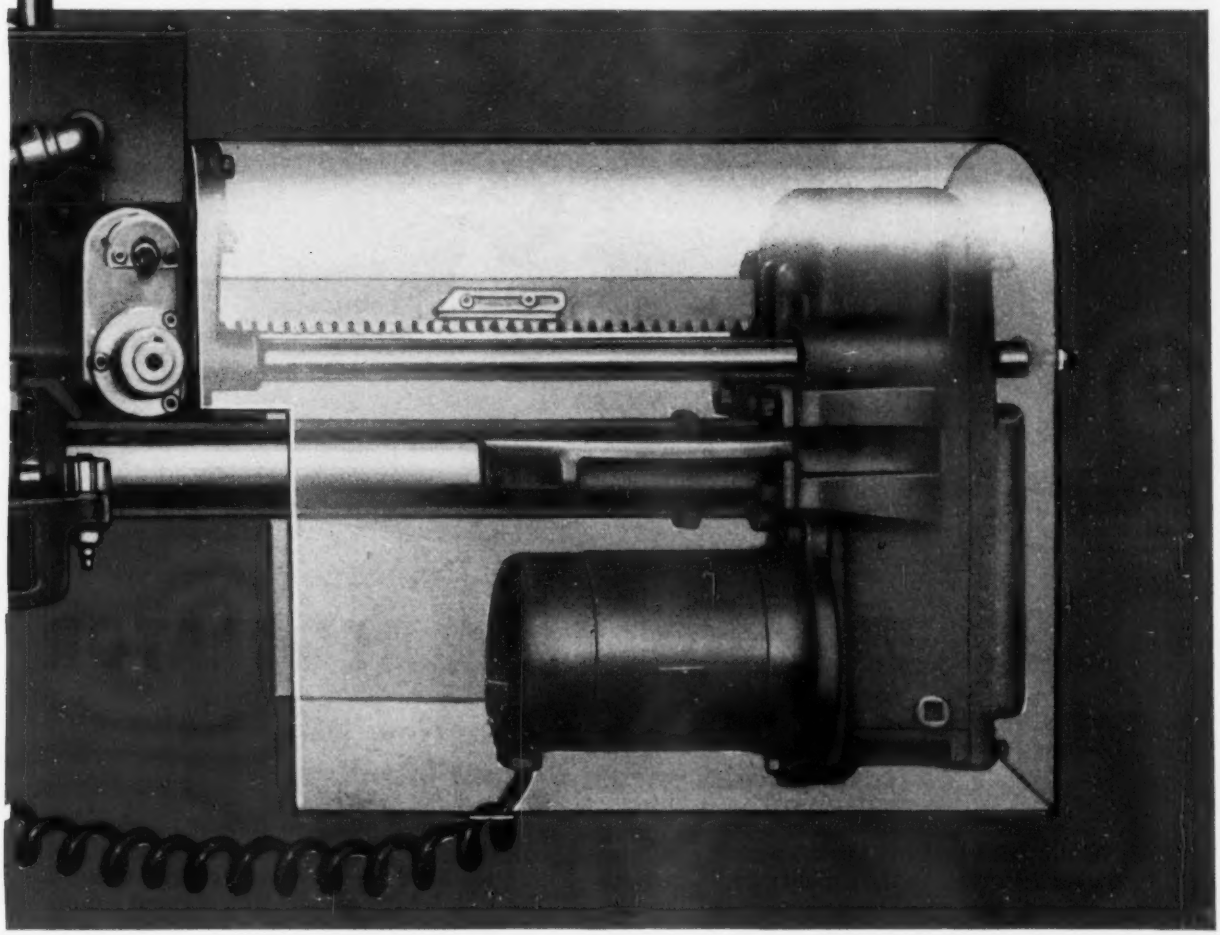
With direct-acting valve
Clean BETTER and FASTER

KEEP slag and sintered dust from upsetting heat-transfer capacity and superheat or reheat control. Stop their build-up—quickly and effectively—with the high-power mass blowing and fast action of Vulcan Wall Deslaggers.

Thanks to dual-motor drive—electric or air, electric shown—a Vulcan Deslagger

VULCAN *Automatic*

SLAG BUILD-UP



extends into the boiler, cleans and retracts from the high-temperature zone—all in 76 seconds. The cycle can be repeated often, if needed to control deposits.

Steam, air or water—or any combination of them—may be used as the blowing medium without change in equipment. The blowing or cleaning arc can be any angle up to a full 360 degrees.

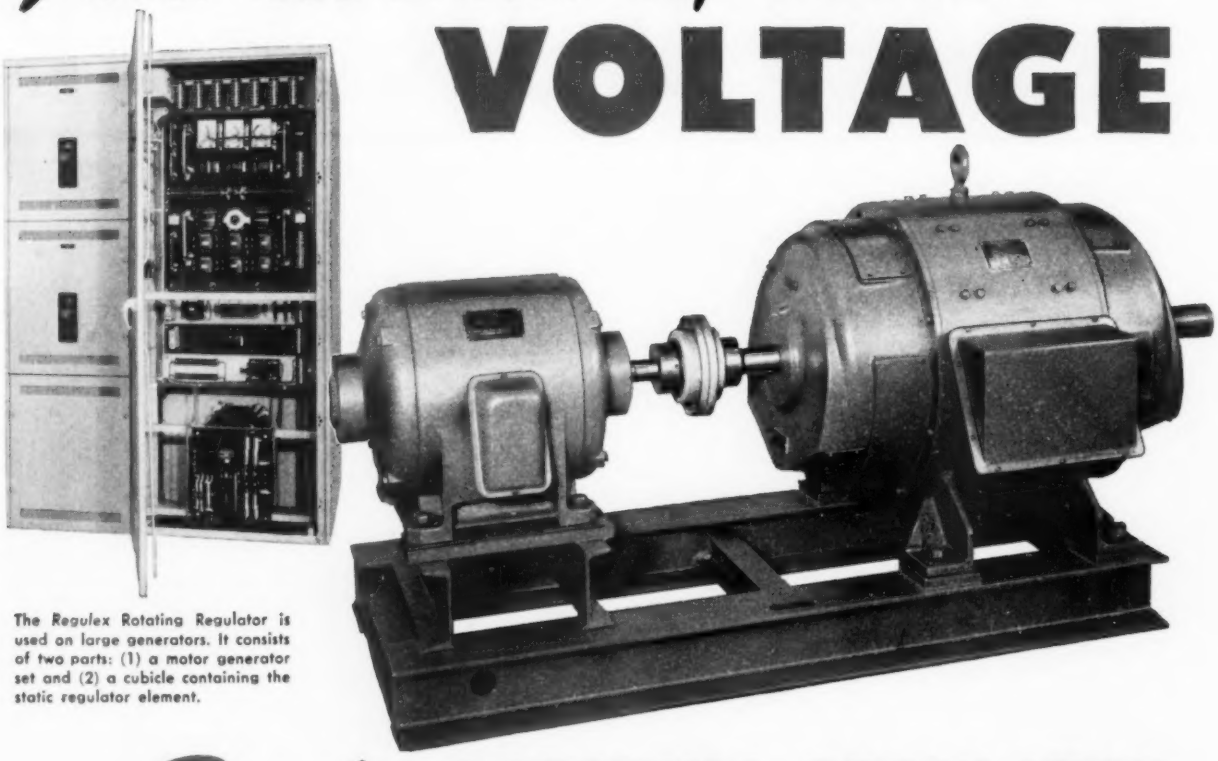
The story is told in detail by new Bulletin 1016. Write for it.

COPES-VULCAN DIVISION

CONTINENTAL FOUNDRY & MACHINE COMPANY

ERIE 4, PENNSYLVANIA

Fast, accurate, dependable VOLTAGE



The *Regulex* Rotating Regulator is used on large generators. It consists of two parts: (1) a motor generator set and (2) a cubicle containing the static regulator element.

Regulex ROTATING REGULATOR

★ **Maximum Productivity from New Generators**
★ **New Efficiency from Present Installations**

Regulex voltage regulators incorporating automatic minimum excitation permit generator operation close to the stability limit . . . much closer than manual operation allows. The sensitivity and exceptional response of the *Regulex* voltage regulator and associated equipment establish and maintain a safe ratio between generator load and field current . . . increase operating limits at any given power factor load . . . assure the proper reactive kva division. The *Regulex* voltage regulator does not require multiple special fields in the exciter — may be applied to any standard shunt machine. Write for literature. A-4189

New Magnetic and Electronic Amplifiers

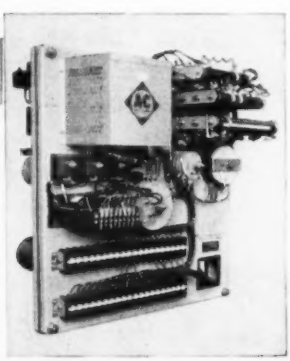
Versatile "Tools" Used in Solving Your Particular Voltage Regulation Problem

For special industrial and military regulating systems, added flexibility is obtained by using magnetic and electronic amplifiers. These components *supplement* but do not replace the *Regulex* rotating amplifier in most applications.

The magnetic amplifier is used primarily where reversible output from the amplifier is not required. Special exciter design is eliminated in such applications. The shock-proof characteristics of the magnetic amplifier make it particularly adaptable to military voltage control.

Electronic amplifiers are used only on applications that require exceptionally high sensitivity.

Applications of magnetic and electronic amplifiers for purposes other than voltage control include speed, current, and tension regulation.



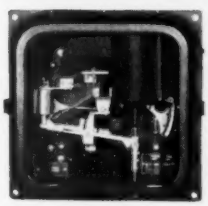
Voltage regulator with current limiting device. Used for control of static rectified dc power supply.

REGULATION
For ANY Size Generator

Rocking Contact VOLTAGE REGULATORS

dc Applications

The Type VD Regulator has been designed to meet the demands of voltage or current characteristics of dc machine operation. Resistors are cut in and out of the exciter shunt field by the *Rocking Contact* sector. No sluggish, time wasting relays. No vibrating or sliding contacts to wear out. A small movement of the *Rocking Contact* sector over a curved commutator covers the entire regulating range. Type VD regulators are available for all dc generators. Write for Bulletin 14B6137A.



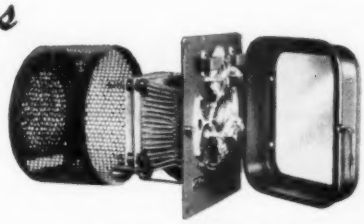
VD-2 Regulator for dc generators from 10 kw at 80 rpm to 200 kw at 3600 rpm

ac Applications

Types V-00 and 221 Regulators

FOR SMALL GENERATORS

Rocking Contact Voltage Regulators are available in two types for use on small ac generators with direct-connected exciters — Type V-00 for generators to 157 kva maximum at 3600 rpm; Type 221 for generators to 438 kva maximum at 3600 rpm. These regulators can be modified for temperature compensation, shock mounting or other special requirements. Bulletin 14B6143A gives details.



Types A, B, & C Regulators

FOR MEDIUM SIZE GENERATORS

Types A, B, and C Regulators differ only in kva range.

Type A Regulator—for ac generators, 125 kva at 257 rpm to 1750 kva at 3600 rpm.

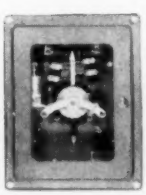
Type B Regulator—for ac generators, 1000 kva at 257 rpm to 6250 kva at 3600 rpm.

Type C Regulator—for ac generators from 3125 kva at 257 rpm to 25,000 kva at 3600 rpm.

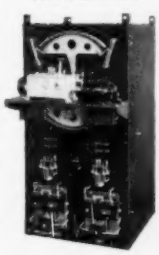
All have guaranteed sensitivity of plus or minus 0.5%. Write for Bulletin 14B6035B.

FOR LARGE GENERATORS

Type J *Rocking Contact* Regulators are of the exciter field rheostatic type designed for the control of large synchronous machines. This regulator consists of two parts: (1) a voltage sensitive torque motor control element for panel mounting; (2) a motor-operated exciter rheostat with high speed field forcing contactors. Write for Bulletin 14B6015A.



Type J Element



Motor-Operated Rheostat

Regulex and Rocking Contact are Allis-Chalmers trademarks.

ALLIS-CHALMERS

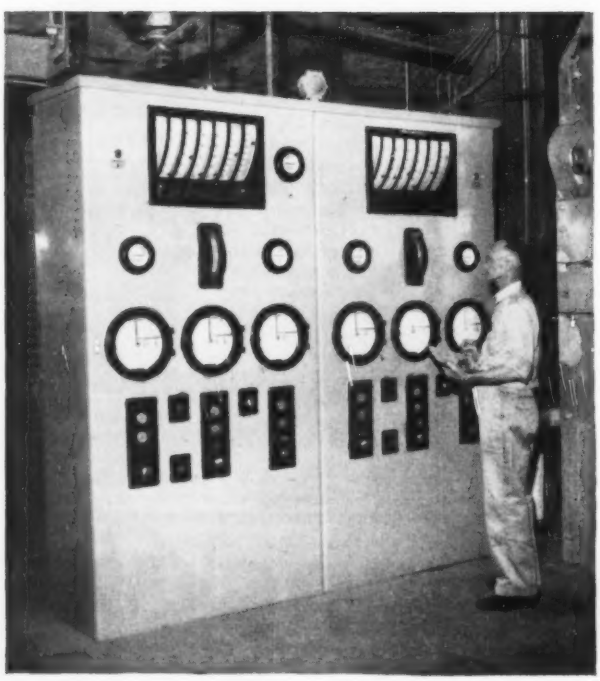
Milwaukee 1, Wisconsin

Boiler room at Kansas State College. Republic instrument panel is at left. Boilers are arranged for either gas or oil firing.

REPUBLIC *Automatic*

COMBUSTION CONTROLS

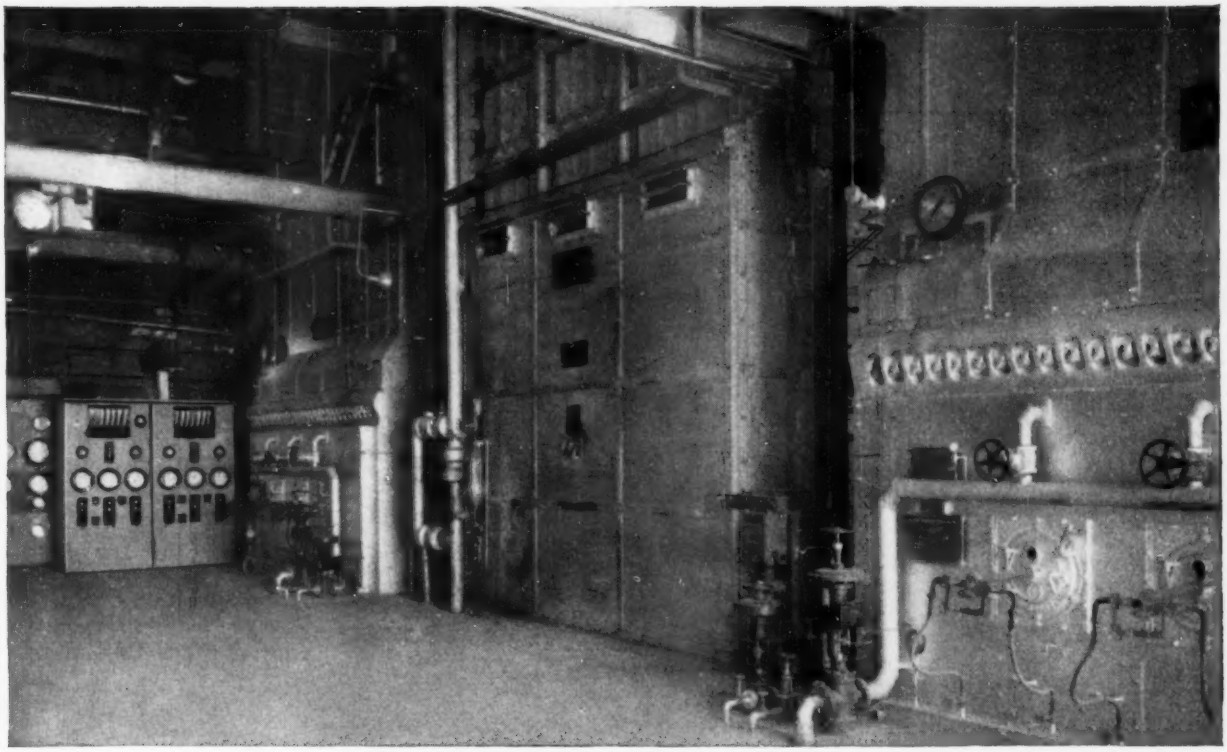
Go to College to



● At Kansas State College, a complete Republic combustion control system, feedwater level controls and instruments automatically operate two 50,000 pounds per hour boilers for maximum combustion efficiency. Fired by either oil or gas, these boilers generate steam at 225 psig and 500° F.

With Republic automatic combustion controls in this power plant, all loads,

Instruments on the control panel monitor boiler operation. If desired, the entire combustion system can be operated manually from this panel.



Cut Steam Costs

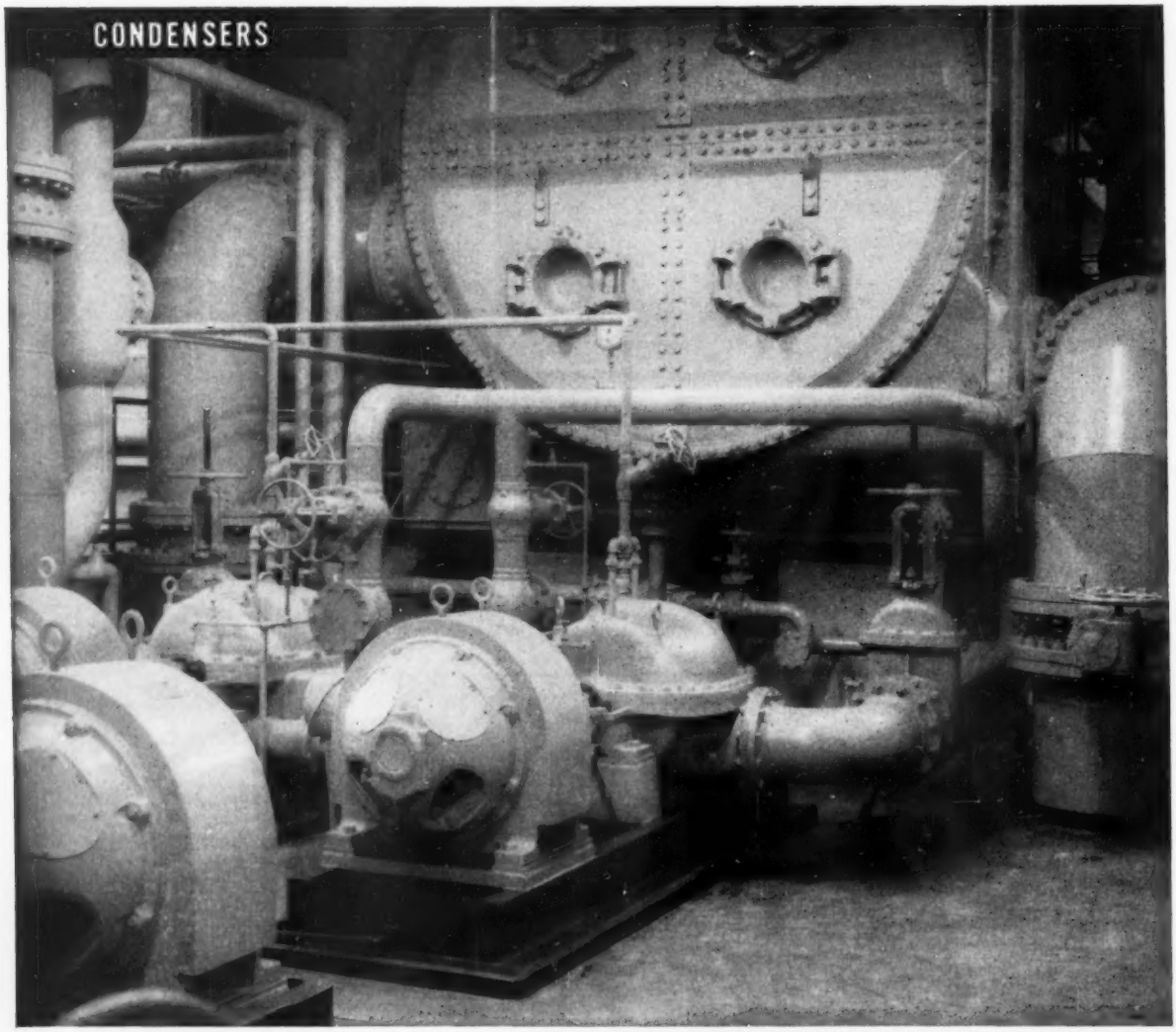
including "peaks", are met smoothly with steam output exactly matched to demand. Fuel costs per pound of steam produced are kept at a minimum 24 hours a day, seven days a week. Maintenance costs are kept low, too, by *continuous* proper operation of the boilers.

Whatever the size of your boiler, its draft arrangement, type or types of fuel to be fired and load conditions to be met, there's a Republic combustion control system that can bring these advantages to you. Our engineering staff, with more than 37 years *specialized* experience in combustion control systems, is at your service to help you get the system that exactly meets your needs. For your convenience, there's a nearby Republic field engineer to bring you all the facts. Write and make a date to see him soon.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

Worthington Steam

News and information about Worthington equipment for the steam power plant



WORTHINGTON'S 37,500 SQUARE FOOT CONDENSER at Columbus and Southern Ohio's E. M. Poston Station

Shallow wells supply all water for this Worthington-equipped power plant

The E. M. Poston Generating Station of the Columbus and Southern Ohio Electric Company, presently rated at 200,000 kw, gets its entire water supply from shallow wells 7000 feet away from the plant site. A 40-million gallon reservoir stores well water for emergency use.

Worthington equipment at the Poston Station now includes 3 condensers with all auxiliaries, including steam-jet ejectors, circulating water and condensate pumps—also deaerators, evaporator preheaters, and miscellaneous equipment.

Worthington, with over a century's experience in the manufacture of steam power equipment, is equipped to build efficient condensers in sizes to suit any practical limitations. Recently, the largest single-shell condenser in the world—125,000 sq. ft.—was made by Worthington for a large utility.

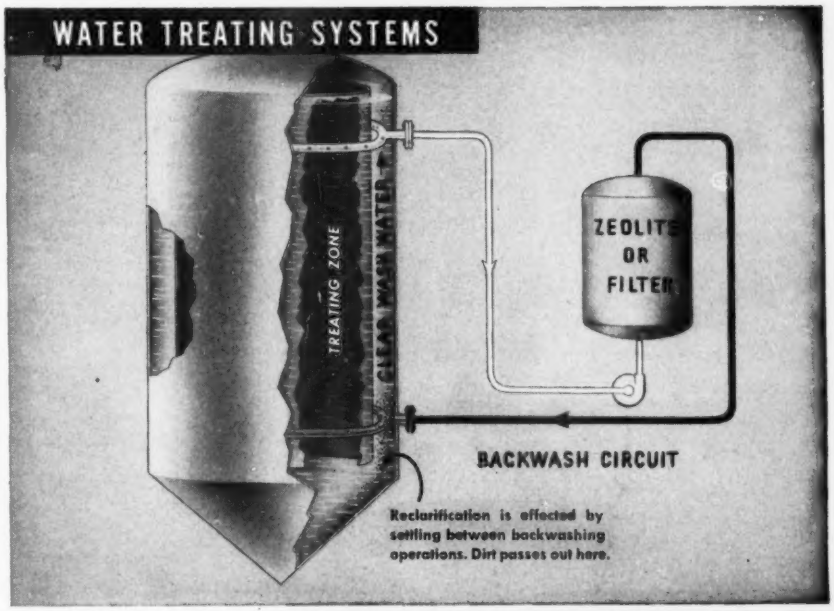
Power Bulletin

Condensers, deaerators, water-treating systems, and steam-jet ejectors and vacuum pumps as well as turbine generators, mechanical drive turbines and gears, circulating, condensate and boiler feed pumps, pressure filters, and air compressors.

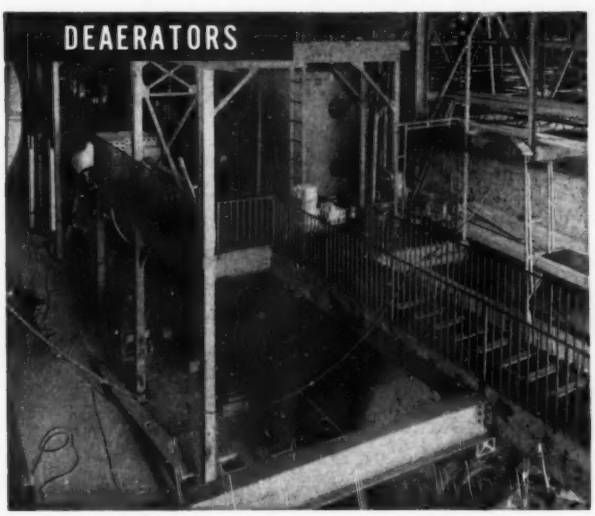
You can't wash clean with dirty water!

Every Worthington standard Hot-Z or conventional system provides exclusive, *independent* facilities for backwashing zeolite or filters with clean, hot, chemically inert water, without disturbing the normal flow through the reaction tank.

This unique backwashing provision is just one of many Worthington exclusive features, but it alone more than justifies the selection of a Worthington system for hot-processing boiler feedwater in your plant.


WATER TREATING SYSTEMS
TREATING ZONE
CLEAN WASH WATER
ZEOLITE OR FILTER
BACKWASH CIRCUIT
Reclarification is effected by settling between backwashing operations. Dirt passes out here.

BACKWASH FLOW CIRCUIT IN WORTHINGTON HOT-PROCESS SYSTEM shows how *independent* built-in annular wash-water compartment* provides clean, hot, chemically inert water for backwashing.
*Reg. U.S. Pat. Off. 2,263,398



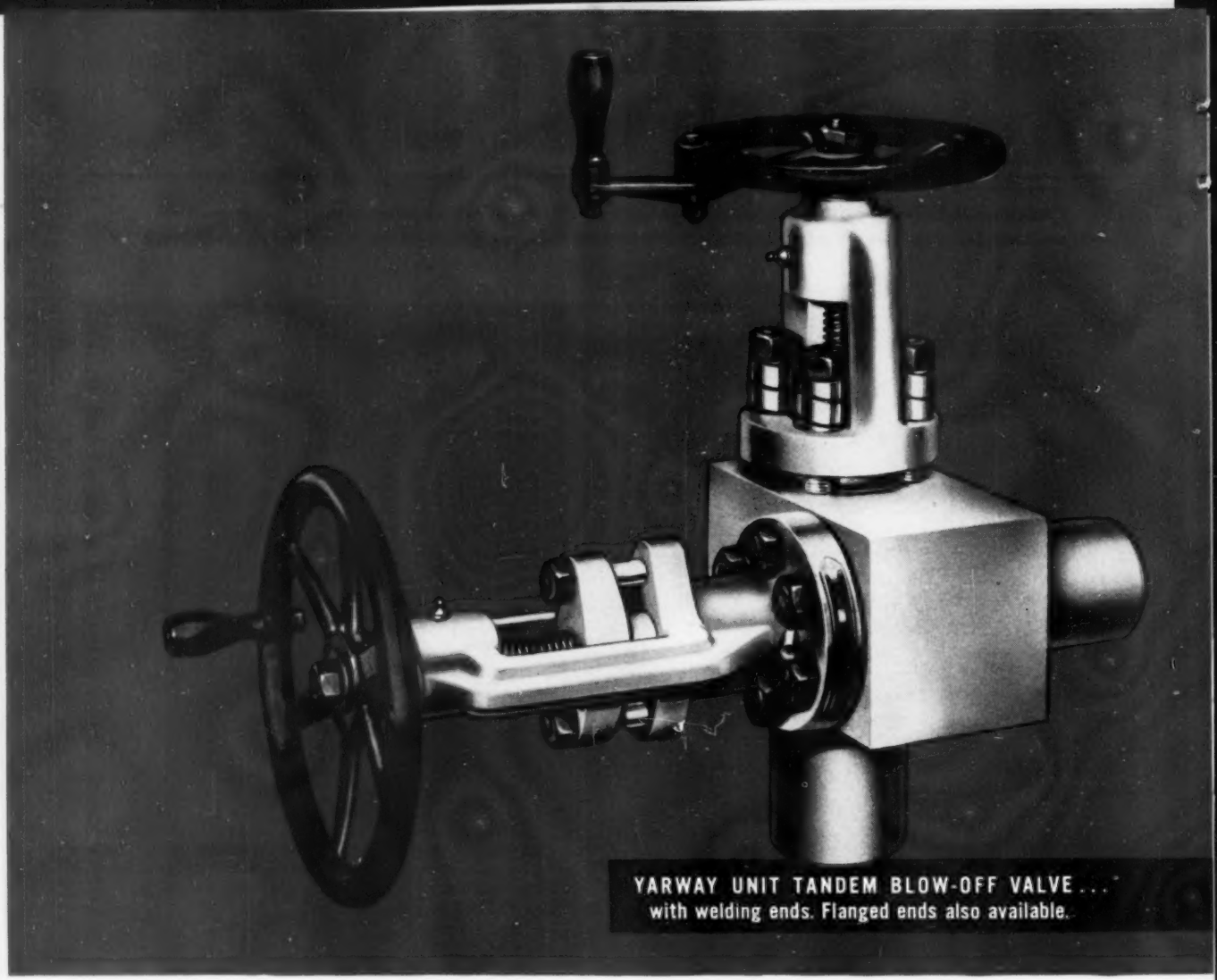
Dayton installs its newest Worthington deaerator

Worthington has supplied the deaerators for each new Dayton Power and Light Company installation since 1936. This new deaerator being installed at the O. H. Hutchings Station, in southwestern Ohio, is one of many Worthington units built in sizes to handle from a few thousand pounds per hour to over a million. Both tray and steam-jet types are made, with external surface-type vent condensers or internal direct-contact vent condensing. With a complete range of sizes and types at their fingertips, Worthington engineers can give you a deaerator exactly suited to your needs.

S.3.1B

Get in touch with your nearest Worthington district office for bulletins and information. Or write to Worthington Corporation, Steam Power Division, Section S.3.1, Harrison, N. J.

WORTHINGTON



YARWAY UNIT TANDEM BLOW-OFF VALVE . . .
with welding ends. Flanged ends also available.

BUILT TO "TAKE IT" AT

HIGH PRESSURES

● As boiler pressures go up . . . so does the demand for Yarway Unit Tandem Blow-Off Valves. *Why do more than 4 out of 5 high-pressure boiler plants now use Yarway Blow-Off Valves?*

Yarway Unit Tandems are designed for strength, built to safeguard lives and investments, and to withstand severest acid-wash service.

A rugged, compact one-piece forged steel block serves as the space-saving common body for both valves, eliminating intermediate connections. Stelliting on seats and discs in the hard-seat valves provides longer life and better service. Balanced sliding plungers do the same on the seatless-type valves. Other design and metallurgy features add a high safety factor.

A FEW TYPICAL USERS — UTILITIES

Pacific Gas and Electric Company
Dallas Power and Light Company
Boston Edison Company
Cleveland Electric Illum. Co.

HARD-SEAT (Blowing) VALVE

Stellited and ground disc and seat.

Cast Steel Yoke.

Stainless steel stem.

Alemite lubrication (fitting on yoke hub) of stem and bushing threads.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Inlet and outlet nozzles welded into body. Flanged or welding ends provided.

SEATLESS (Sealing) VALVE

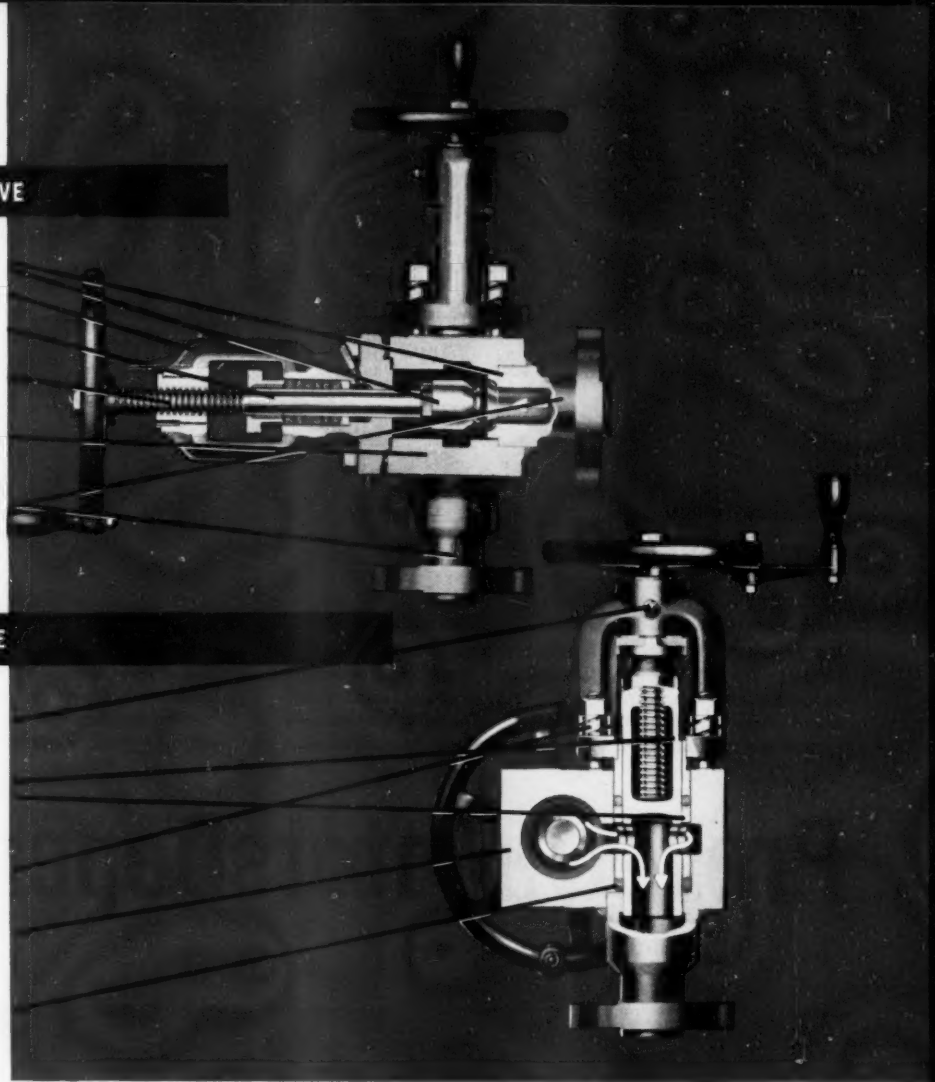
Alemite lubrication of plunger and ball thrust bearing in yoke.

Nitralloy plunger and lower follower gland. Stainless steel plunger and Ni-Resist gland available for acid wash service.

Yoke springs maintain required pressure on packing at all times.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Laminated lower packing ring with stainless steel reinforcing inserts.



Unit Tandems are available in the hard seat—seatless valve combination for pressures to 1500 psi, or in the hard seat—hard seat combination for pressures to 2500 psi. Both provide positive opening and closing with drop-tight shut-off.

Write for Yarway Bulletin B-434.

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES

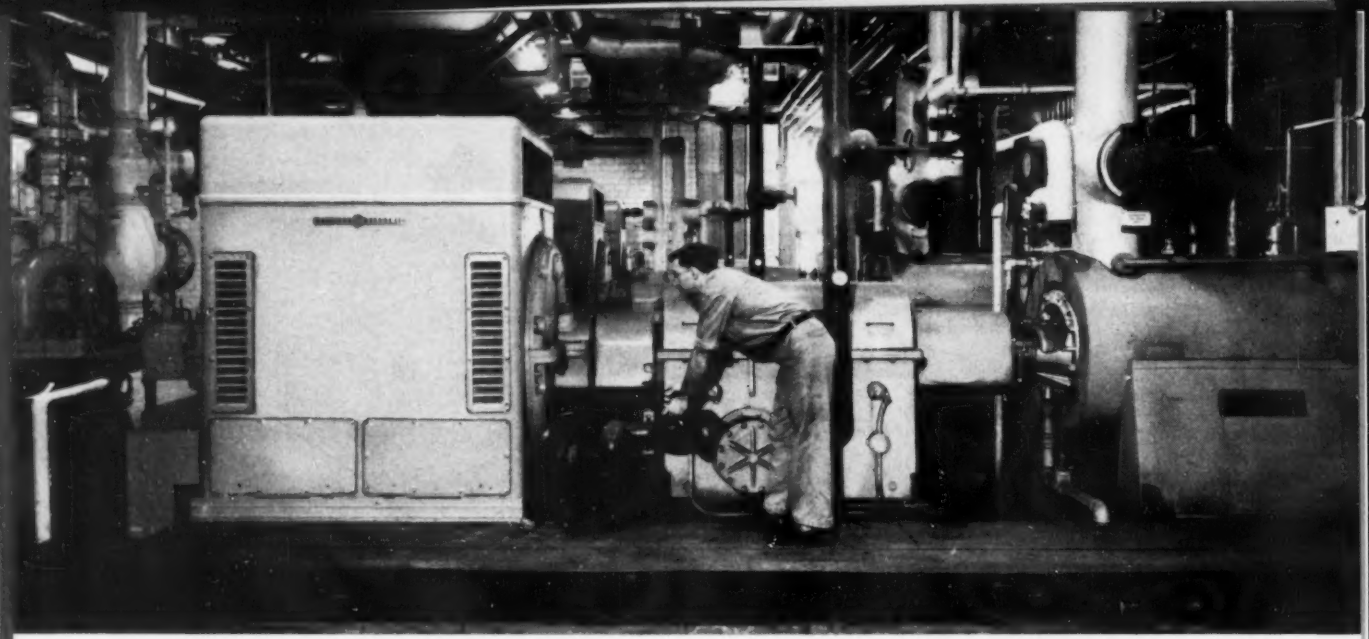
YARWAY® blow-off valves

INDUSTRIAL PLANTS

Toledo Edison Company
Georgia Power Company
Union Electric Co. of Missouri
Rochester Gas and Electric Co.
Indianapolis Power and Light Co.

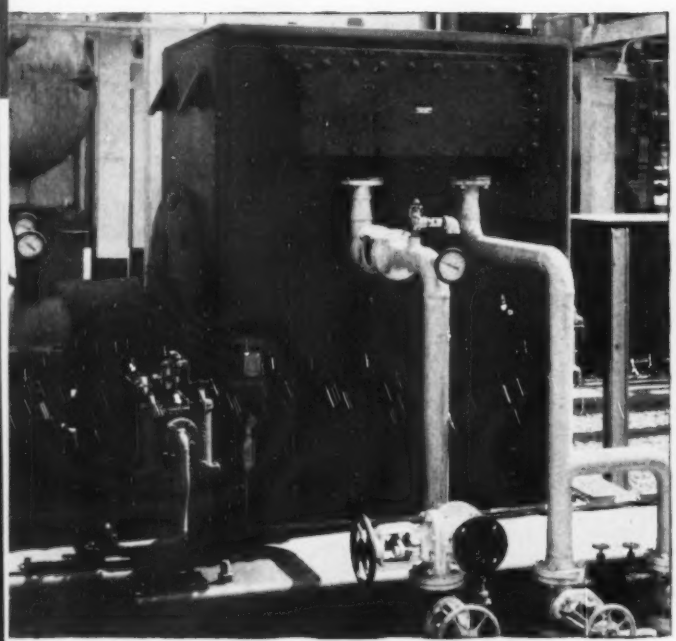
Ford Motor Company
Weyerhaeuser Timber Co.
Anheuser Busch Company
Procter & Gamble Company

Chrysler Corporation
Container Corp. of America
Eastman Kodak Company
American Viscose Company

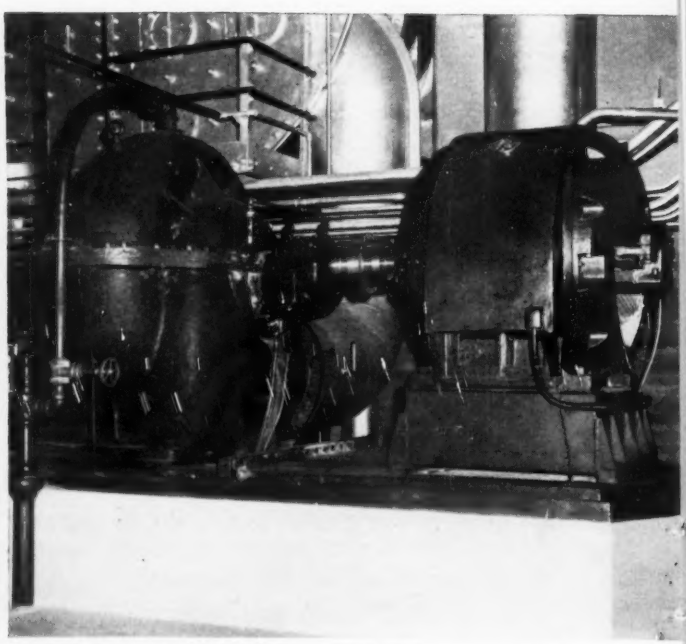


G-E BOILER FEED PUMP MOTORS in a typical application at Detroit Edison's Connor's Creek Plant. Designed especially for boiler feed pump service, 1000 hp ratings and larger, this motor permits closer spacing because of unique ventilating system and cubical shape . . . conserves floor space. You get improved performance from streamlined rotor design which also gives quieter operation. Dual lubrication system combines the advantages of force-flood lubrication and self-lubricated oil rings. Modern appearance blends with power station styling. Write for Bulletin GEA-5813.

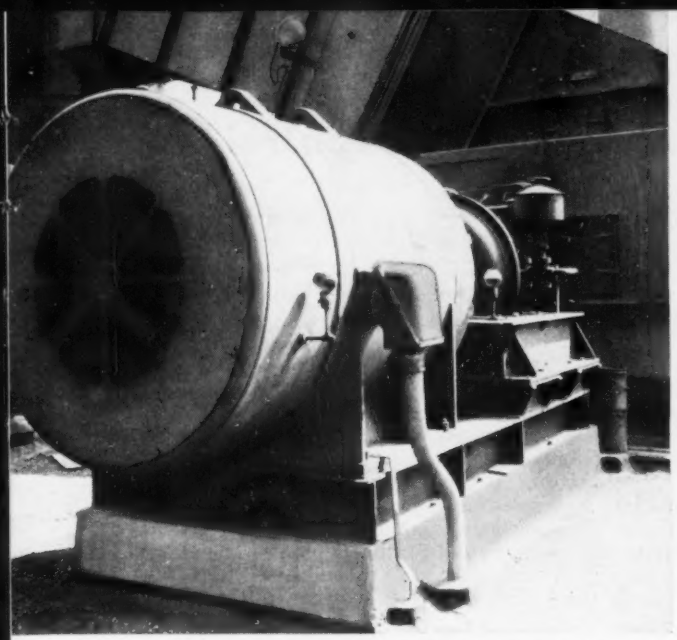
Proved Motor Dependability



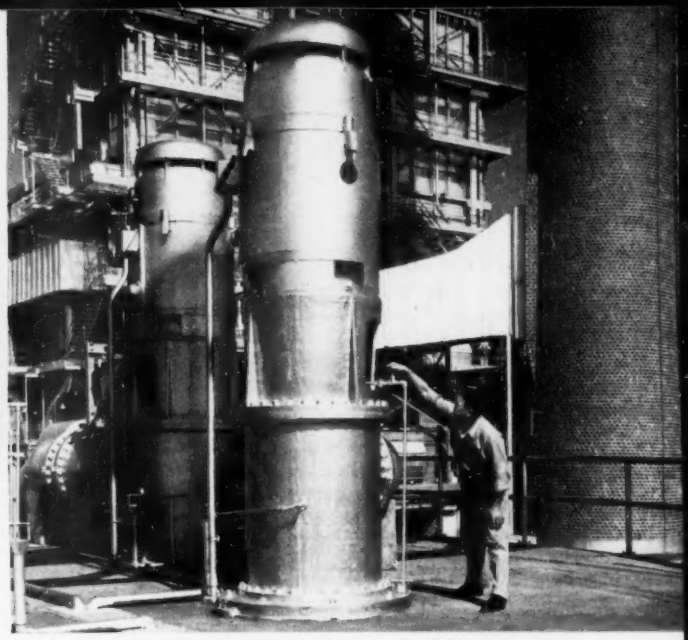
G-E TOTALLY ENCLOSED AIR-WATER COOLED MOTOR is an economical choice for 250 hp and larger. Simple to install, it needs no ducts, filters or blowers. Total enclosure means less maintenance by keeping out dust and other foreign particles. Shown here driving blower in a Kansas plant.



LARGE G-E OPEN DRIPPROOF MOTORS, four or more poles, such as this one coupled to circulating water pump in Cliffside Steam Station of Duke Power Company, are designed for indoor applications only. They are widely used on hot well pumps, forced- and induced-draft fans, and coal pulverizers.

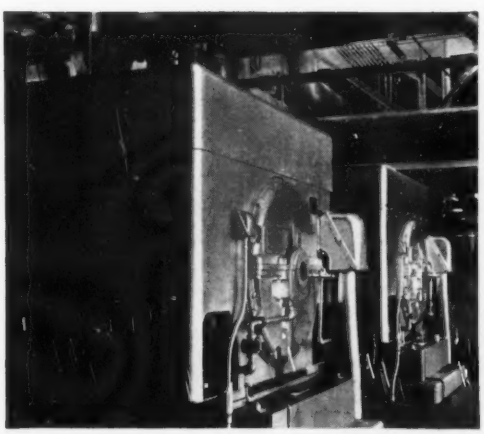


THIS G-E TOTALLY ENCLOSED FAN-COOLED MOTOR drives an induced-draft fan in the Edwardsport Steam-electric Power Station of Public Service Company of Indiana. Total enclosure assures the ultimate in motor protection required for operation in severe atmospheric conditions.



G-E VERTICAL TOTALLY ENCLOSED FAN-COOLED MOTORS, with Tri-Clad* construction, such as these driving pumps at New Orleans Public Service Inc., A. B. Paterson Steam-electric Generating Station, are used for dependable, low-maintenance service in severe ambient conditions.

for Power Station Service



TWO G-E WEATHER PROTECTED MOTORS, grade mounted, driving boiler feed pumps at Florida Power & Light Company's Cutler Plant. Available also in vertical and base ventilated design, this low-cost motor is designed especially for outdoor service where the extra protection of totally enclosed fan-cooled design is not economically justified. Bulletin GEA-5810.

*Reg. Trade-mark of General Electric Co.

G.E.'s complete line of power station auxiliary motors—field proved—assures you of getting the right motor for every operating requirement and station design.

Power stations across the country have installed dependable G-E motors for every auxiliary use. Because of the extensive field study that General Electric has devoted to power station requirements and the engineering experience gained through building all types of power station equipment for over 70 years, you are always assured of getting the right motor for economical and dependable service.

Whatever your needs in power station motors, General Electric can furnish the right type and size from a complete line . . . a wide variety of designs, enclosures, and application variations. You get exactly the motor needed to meet conditions of your operating practice, economics or location.

For more information on G.E.'s complete line of power station auxiliary motors contact your nearest G-E Apparatus Sales Office. *General Electric Co., Schenectady 5, N. Y.* 753-6

GENERAL ELECTRIC

Application engineering . . . *essential to control*

No matter what the product, every plant uses methods, materials and equipment that present problems peculiar to its own production. Specifications . . . size of plant . . . rate of output . . . all impose further unique restrictions.

What, then, about process control instrumentation? To do its job right, it has to be designed with all those factors . . . and many others . . . in mind. And here is where Honeywell Application Engineering steps in.

First comes a thorough investigation of control requirements. A Honeywell engineering representative, well versed in instrumentation techniques sits down with process engineers, production men, and instrument technicians . . . discusses details of the specific process. Then he puts the problem up to Honeywell's staff of application engineers.

Specialists for Each Industry

In this group are men who are expert in each specific industry. One group, for example, specializes in instrumentation for the metalworking industry . . . another for chemical . . . another for petroleum . . . until the whole gamut of modern manufacturing is represented. Each man has been trained, by education and first-hand experience, in the techniques of processing and process control in the area of his interest. Each is a living part of the industry he serves. And he knows why and where every process "is different."

Covers All Aspects of Control

Honeywell application engineering covers the entire control installation. It works out details of what instrument to use for each measurement or control function . . . what type of primary element . . . what control system . . . what size and style of valve. It provides all essential signals, safety interlocks, and accessories. It combines all these elements into a complete unit, arranged for peak production efficiency . . . greatest convenience of the operator, and for maximum ease of service . . . custom-fitted to the individual needs of the process to be controlled.

Saves Time . . . Produces Top Performance

This Honeywell service gives specialized consultation on complex control problems that would otherwise require the attention of experts in the individual plant. But most important, it assures a control system that will produce the superior performance that Honeywell instruments are capable of giving . . . and which will help to obtain the most production and best quality from the process which it serves.

Remote measuring *centralized*

SOUND PLANNING, *based on specialized engineering experience, forms the basis of Honeywell Application Engineering. Here a round-table discussion between customer and Honeywell technicians irons out the initial control requirements for a process.*

WHEREVER you need to bring measurements of flow, liquid level and pressure from out in the plant to a central control room, you'll find Brown remote measuring systems provide the performance you need. Utilizing pneumatic transmission, these systems consist of an appropriate transmitter and sensing element at the point of measurement—connected by small-diameter tubing to recording and controlling instruments on the main or auxiliary control boards.

They're accurate: operate over distances of several hundred feet with full responsiveness. Transmitter and receiver are precision-matched in design.

They're dependable: rugged design keeps calibration constant, from detection to final measurement. Simple construction minimizes maintenance.

Brown pneumatic transmission systems are supplied in a wide choice of ranges for power plant service.

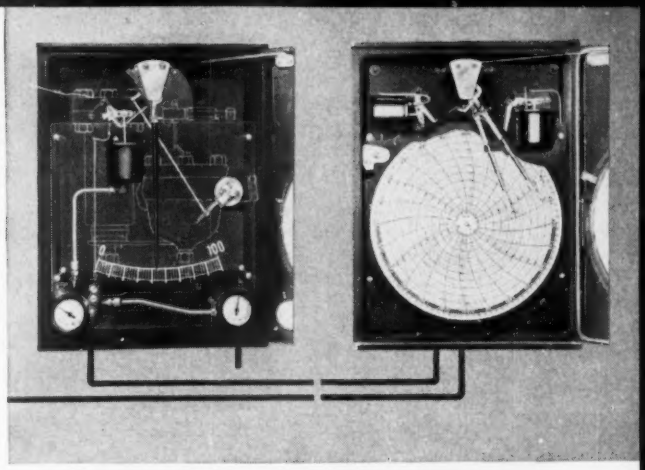
systems for *plant control*

Electric systems are also available for these same variables. Your local Honeywell engineering representative will welcome the opportunity to discuss your own plant's applications . . . and he's as near as your phone.

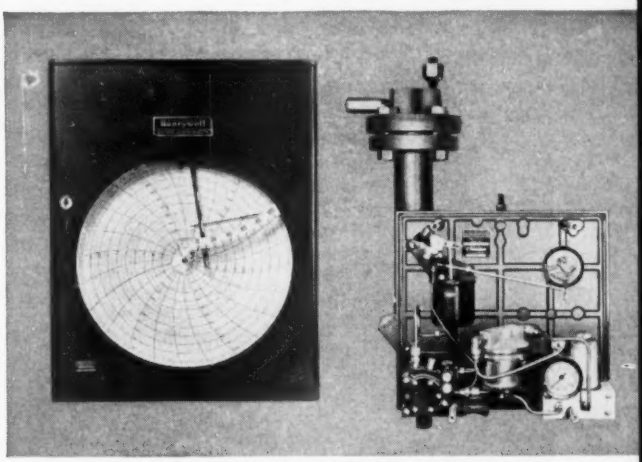
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa. Sales and service offices in more than 90 principal cities of the United States and Canada.

● **REFERENCE DATA: Write for Catalog 90-2, "Supervisory Instruments for Power Generation," and for Data Sheet No. 9.1-4.**

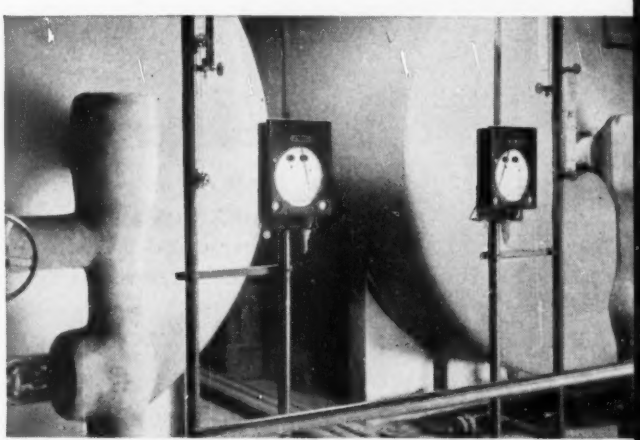
MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



REMOTE PRESSURE MEASUREMENT: *Brown systems cover the range from super heat pressures to condenser vacuum. Only low-pressure instrument air goes to the control board. Dangers of high-pressure piping are eliminated . . . panel costs are reduced.*

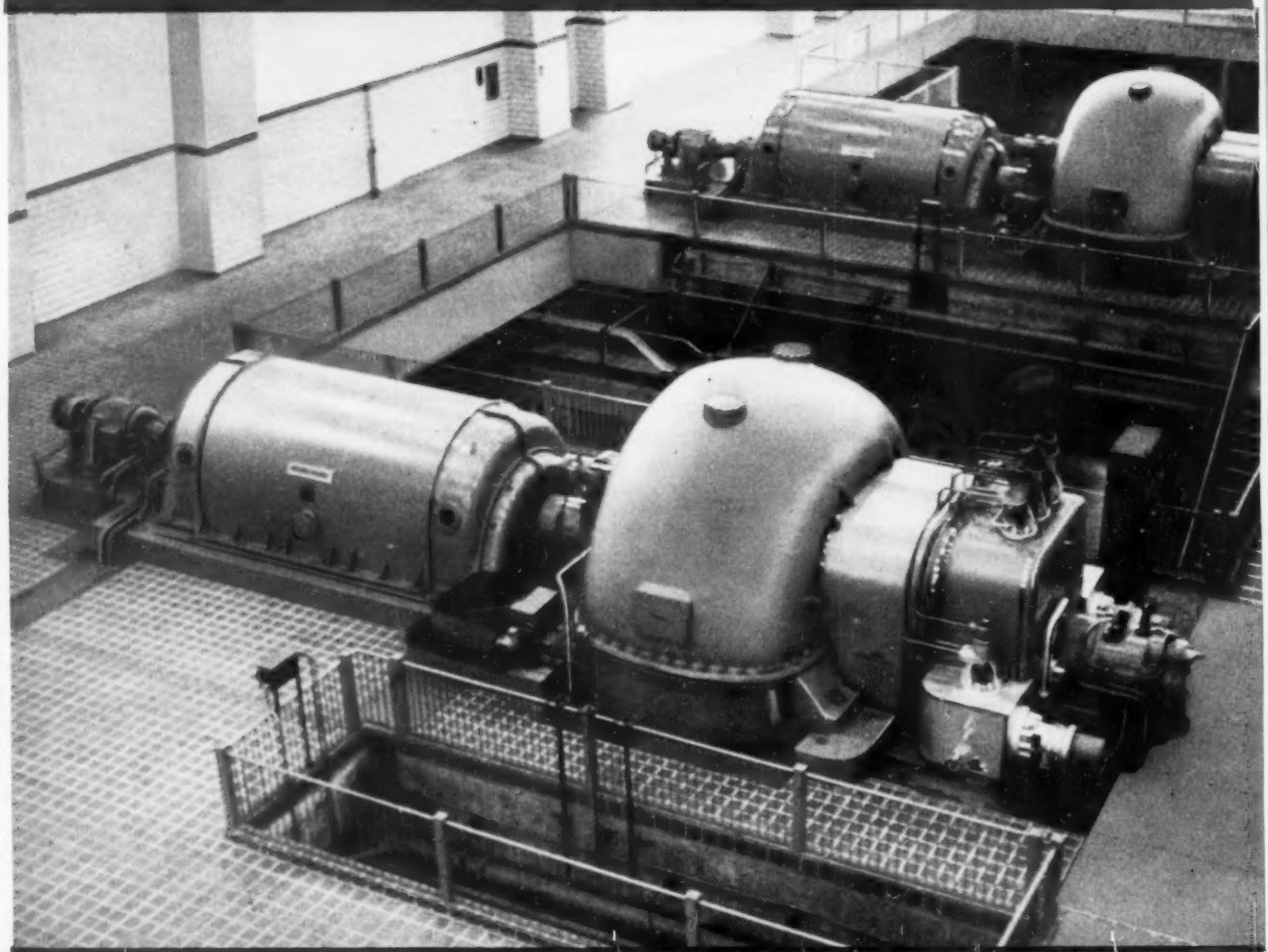


REMOTE FLOW MEASUREMENT: *systems can be either the square root type (electric or pneumatic transmission) or evenly graduated (electric transmission). The latter is ideal for flow cost accounting . . . has a linear scale that provides full readability at all flow rates.*



REMOTE LIQUID LEVEL MEASUREMENT: *keep operators informed of level in condensate tanks, hot wells, boiler drums and other remote locations. Systems are supplied for open tanks, closed pressure vessels, corrosive liquids, and liquids containing suspended solids.*

BROWN



View in the Cleveland Municipal Power Plant with its new Brown Boveri 25,000/32,500 kW turbo-generator sets. The City of Cleveland saved enough on the two units to purchase a third generator if so desired. These units were produced and delivered as scheduled.

Initial economy is not the only factor involved in the selection of Brown Boveri power generating equipment. The proven quality and operating economies of these turbo-generators — evidenced by the consistently dependable, year-after-year performance of similar Brown Boveri equipment — are equally major considerations.

It will pay you to investigate Brown Boveri turbo-generator sets. Write for complete data.

BROWN BOVERI

BROWN BOVERI

19 RECTOR STREET,

BOVERI

TURBO-GENERATOR SETS . . .

"They saved the City of Cleveland over $500,000 in initial cost alone."

says:

EMIL J. CROWN
Director of Public Utilities, City of Cleveland
Cleveland, Ohio

"We have every reason to believe that the two Brown Boveri turbo-generator sets now installed in the City of Cleveland power plant, will meet our every expectation. *They saved the City of Cleveland over $500,000 in initial cost alone.*"

CORPORATION
NEW YORK 6, N. Y.

Unloading Hopper Cars

IS A FAST, ONE-MAN OPERATION

Unloading Time

Actual examples with Allis-Chalmers car shaker. Good unloading facilities.

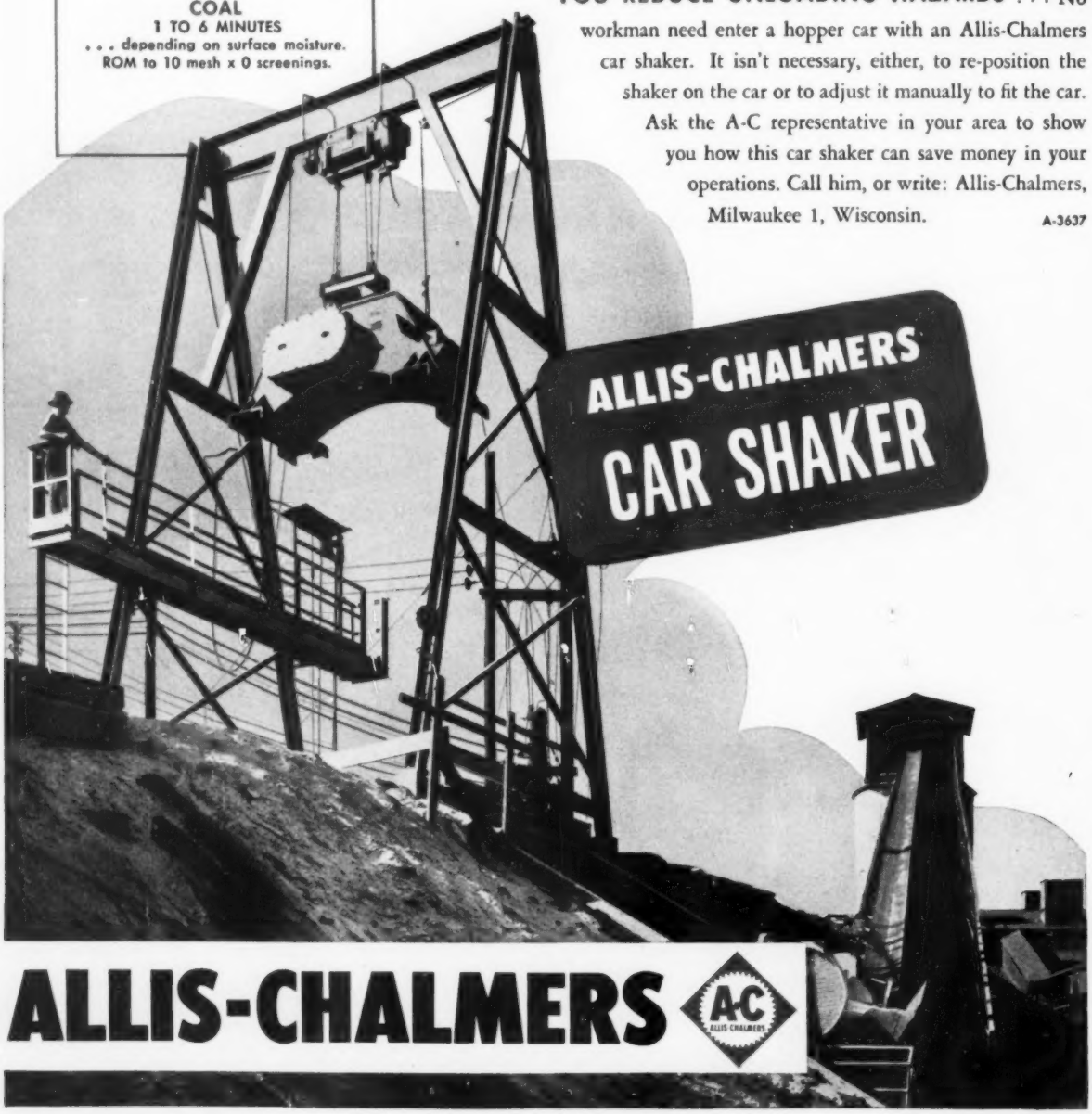
WET SAND
1½ TO 2¼ MINUTES.

ROCK
½ TO ¾ MINUTES
. . . ½ to 6 in. crushed material.

COAL
1 TO 6 MINUTES
. . . depending on surface moisture.
ROM to 10 mesh x 0 screenings.

YOU CUT UNLOADING COSTS . . . Push a button and your Allis-Chalmers car shaker will empty a hopper-bottom car in *minutes* . . . and cleanly, too, even if your bulk material is damp, compacted or partially frozen. In addition, it promotes an even flow of material from the unloading station.

YOU REDUCE UNLOADING HAZARDS . . . No workman need enter a hopper car with an Allis-Chalmers car shaker. It isn't necessary, either, to re-position the shaker on the car or to adjust it manually to fit the car. Ask the A-C representative in your area to show you how this car shaker can save money in your operations. Call him, or write: Allis-Chalmers, Milwaukee 1, Wisconsin. A-3637



ALLIS-CHALMERS A-C ALLIS-CHALMERS

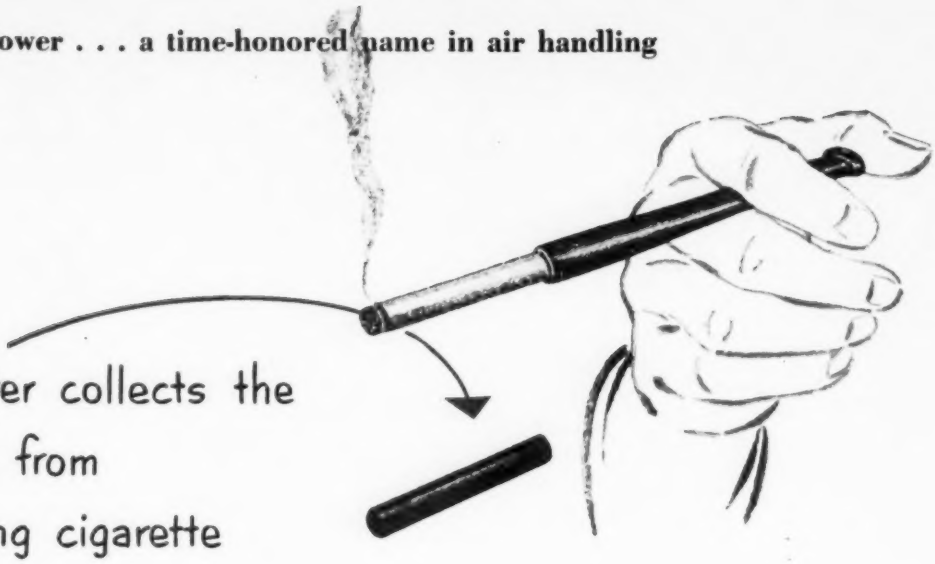
It has been American Blower's privilege to serve these and other producers of power in the public utility field.

Alabama Power Company
Carolina Power & Light Company
Central Arizona Power & Light Company
Central Illinois Electric & Gas Company
Central Illinois Light Company
Columbus & Southern Ohio Electric Company
Connecticut Light & Power Company
Consolidated Edison Company of New York
Consumers Power Company
Consolidated Gas, Electric Light & Power Co. of Baltimore
Connecticut Power Company
Dairyland Power Co-operative
Dallas Power & Light Company
Detroit Edison Company, The
Duke Power Company
Eastern Shores Public Service Company
Fitchburg Gas & Electric Light Company
Florida Power Corporation
Florida Power & Light Company
Georgia Power Company
Gulf Power Company
Hartford Electric Light Company
Indianapolis Power & Light Company
Iowa Public Service Company
Iowa-Illinois Gas & Electric Company
Iowa Power & Light Company
Iowa Electric Light & Power Company
Kansas City Power & Light Company
Kansas Power & Light Company, The
Kansas Gas & Electric Company
Long Island Lighting Company
Los Angeles, California, City of
Louisiana Power & Light Company
Madison Gas & Electric Company
Mississippi Power Company
Missouri Power & Light Company
Niagara Mohawk Power Corporation
Nebraska Public Power System
Northern Indiana Public Service Corporation
Ohio Edison Company
Oklahoma Gas & Electric Company
Omaha Public Power District
Otter Tail Power Company
Pacific Gas & Electric Company
Pennsylvania Power Company
Philadelphia Electric Company
Potomac Electric Power Company
Public Service Company of Oklahoma
Public Service Electric & Gas Company
Public Service Company of Colorado
Southwestern Public Service Company
Southern Indiana Gas & Electric Company
South Carolina Electric & Gas Company
Springfield, Illinois, City of
Tampa Electric Company
Texas Electric Service Company
Texas Power & Light Company
Tennessee Valley Authority
Virginia Electric & Power Company
Worcester County Electric Company of Massachusetts

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

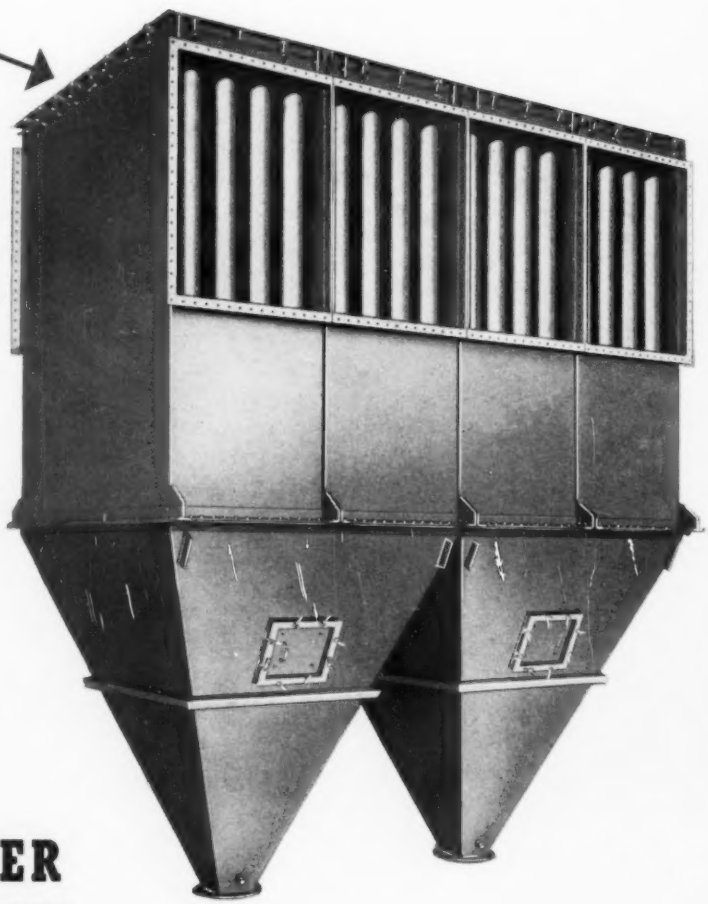
Division of American Radiator & Standard Sanitary Corporation

American Blower . . . a time-honored name in air handling



This filter collects the residue from a burning cigarette

This American Blower Fly Ash Precipitator collects fly ash from boilers burning solid fuels.



Install an American Blower Fly Ash Precipitator in your power plant— and see the difference.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS & WALL TILE · DETROIT CONTROLS · KEWANEE BOILERS · ROSS EXCHANGERS

B.F.Goodrich

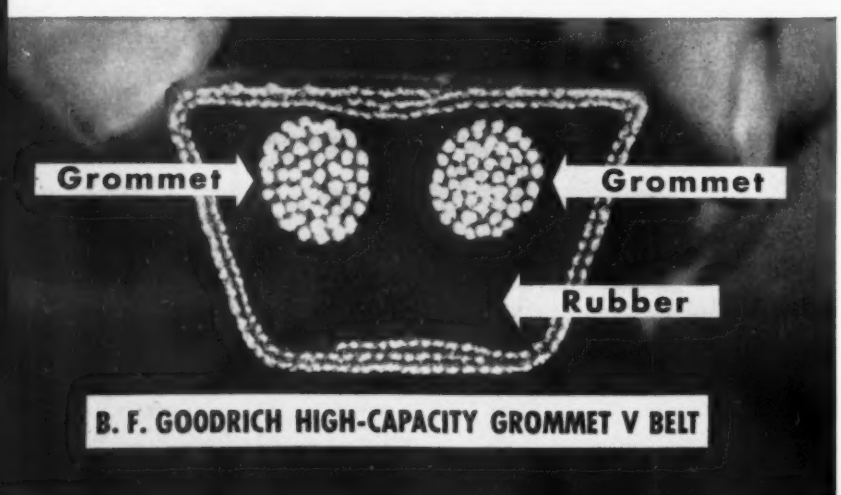
Sparks fly in all directions when 44-inch saw slices through steel billet that's 10 times hotter than boiling water.

Whizzing saw bites steel

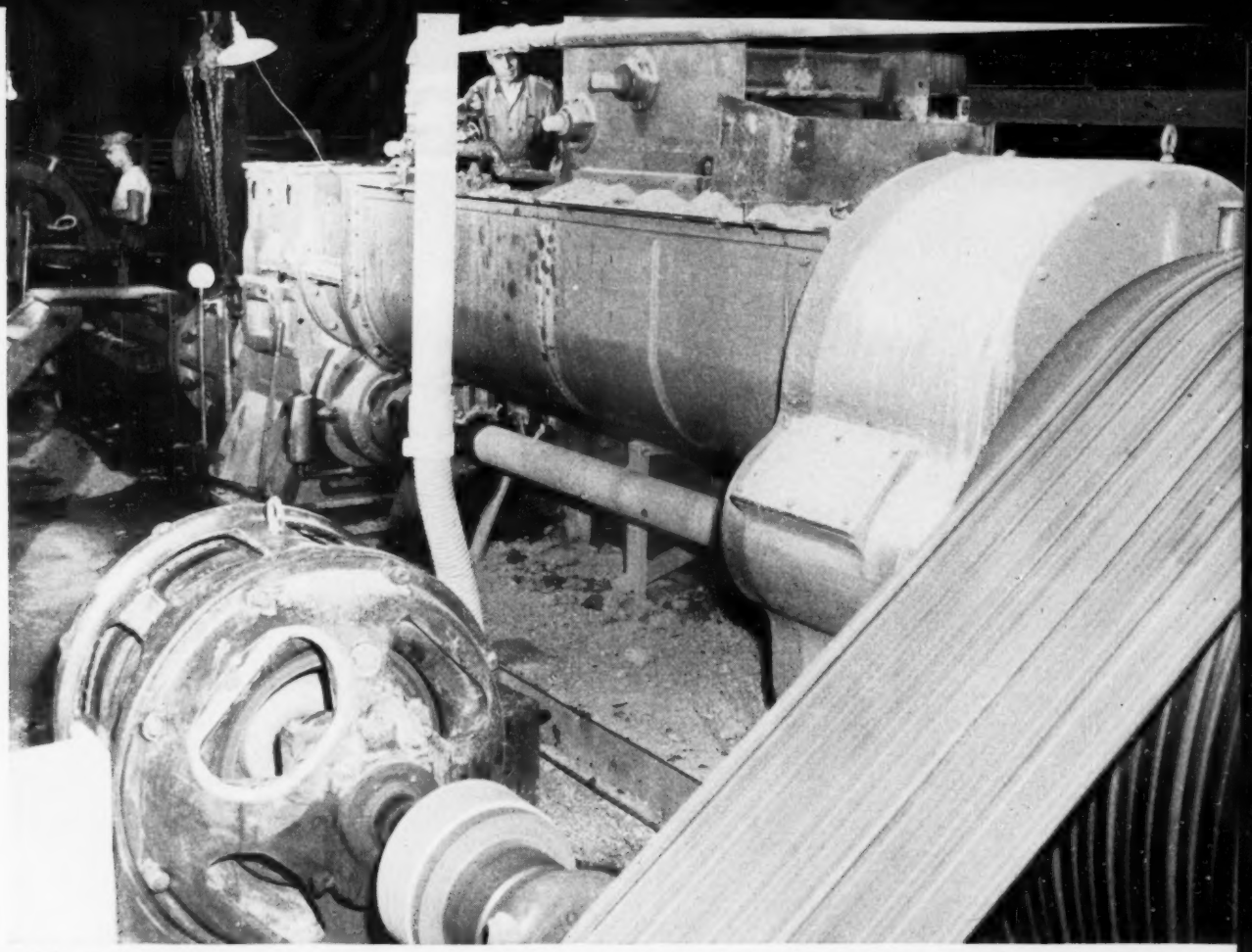
That circular saw has to spin at terrific speed to cut through steel. A belt was used to keep the saw whirling, but the sudden jerks it got when the saw was pushed into the steel made it slip. The saw stopped temporarily, and got such a jerk when started up again, it would crack and have to be scrapped. With $60 saws lasting only two or three days, the steel company (cont. on next page)

Whizzing saw (continued)

It takes just one slip to bring a saw to the breaking point, but an unusual belt solved this problem.



(cont. from preceding page) looked for a belt that wouldn't slip, wouldn't slow down the saw. Then they heard that B. F. Goodrich had developed a V belt for just such tough jobs, and they had a set of high-capacity Grommet belts put on. Since the BFG high-capacity has less stretch than other V belts, the constant speed necessary for smooth cutting is maintained with no slippage. And within the first three months of service, the steel mill saved $1,620 in saw replacement costs, and eliminated the costly shutdown time.



Like squeezing toothpaste out of a tube, clay is forced from that tub-shaped mixer in a continuous strip, then cut into bricks.

10 days stretched into 2 years

Several years ago that electric motor you see in the foreground was rewound and, as a result, it developed more horsepower than was thought possible. Then it was discovered that the V belts, selected by using the original rating on the motor plate, couldn't pull the load. They slipped, squealed, lasted 10 days. Additional belts were needed. But to replace sheaves and belts would cost $300 and, even worse, the plant would lose several days' production. That was the problem until a BFG distributor told them about high-capacity Grommet V belts, built to handle 40% more horsepower than standard V belts. They solved the problem without new sheaves. Those high-capacity belts shown above have been at work two years now, and are still going strong.

40% stronger

The high-capacity Grommet V belt, developed by B. F. Goodrich, carries a 40% higher horsepower rating, reduces belting and sheave costs, cuts maintenance time and lasts longer than any other type of V belt. Here's why:

More flexible

Only with grommet construction is it possible to increase the number of cords reinforcing a V belt and still retain flexibility and resilience. Grommets are cord loops made like giant twisted cables except that they're endless. The B. F. Goodrich high-capacity V belt carries a 40% higher horsepower rating because it's built with larger grommets, having 40% more tensile strength. Increased strength in other belts must be accomplished by using more cord or fabric layers in the base rubber, thus reducing flexibility.

Less stretch

Comparison tests on identical drives show that other V belts stretch at least 65% more (sometimes even 165% more) than the B. F. Goodrich high-capacity. Actually, the Grommet is the only high-capacity belt that doesn't stretch enough to affect the efficiency of the drive. As a result, it practically eliminates the necessity of frequent and costly take-ups.

Carries greater horsepower

With B. F. Goodrich high-capacity belts, extra horsepower can be transmitted with sheaves already in use. For example, with the ability to handle 40% more horsepower, nine high-capacity Grommet belts have done the work of 13 ordinary belts.

Lasts longer

All V belts have load-carrying cords, but only the B. F. Goodrich belt has grommet construction with its greater strength, less stretch, and longer life. Talk to a BFG distributor. Find out how you, too, can make important savings in belting, production and maintenance costs with the 40% stronger high-capacity Grommet V belt.

Willing to settle for one year, but got 2½ despite heavy weight, dust, extreme heat and no time off.

From rocks to blocks

These rubber belts turn a ball mill loaded with steel balls. As the huge mill turns, the balls tumble onto rocks and grind them to a fine powder used in making cement blocks. Engineers knew seven ordinary belts couldn't keep this heavy weight turning, yet the company didn't want the added expense of redesigning the drive. Then a B. F. Goodrich man studied the problem and recommended high-capacity Grommet V belts. Because they're 40% stronger than regular belts, the high-capacity belts lasted not just the one year the owner hoped for, but went on working for 2½ years on a 24-hour day, 7-day week basis.

Grommet—T. M. The B. F. Goodrich Co.

The B. F. Goodrich Company
Dept. M-126, Akron 18, Ohio

I'd like to find out how I can save money with high-capacity Grommet V belts.

☐ Please send further information.

☐ Have a BFG distributor call on us.

Name_____

Firm Name_____

Address_____

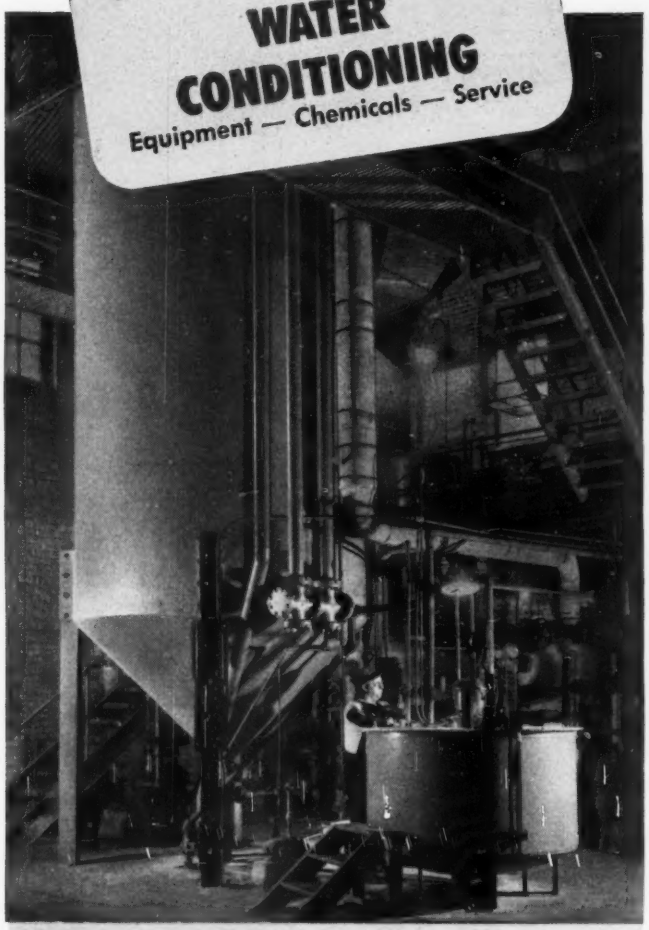
_____

B.F.Goodrich
INDUSTRIAL PRODUCTS DIVISION

Gilbert Paper Co., Menasha, Wis.

Prevents SCALE and CORROSION

ALLIS-CHALMERS WATER CONDITIONING
Equipment — Chemicals — Service



Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 28B6611.

To prevent scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

What Hot Process Lime-Soda System Does

The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

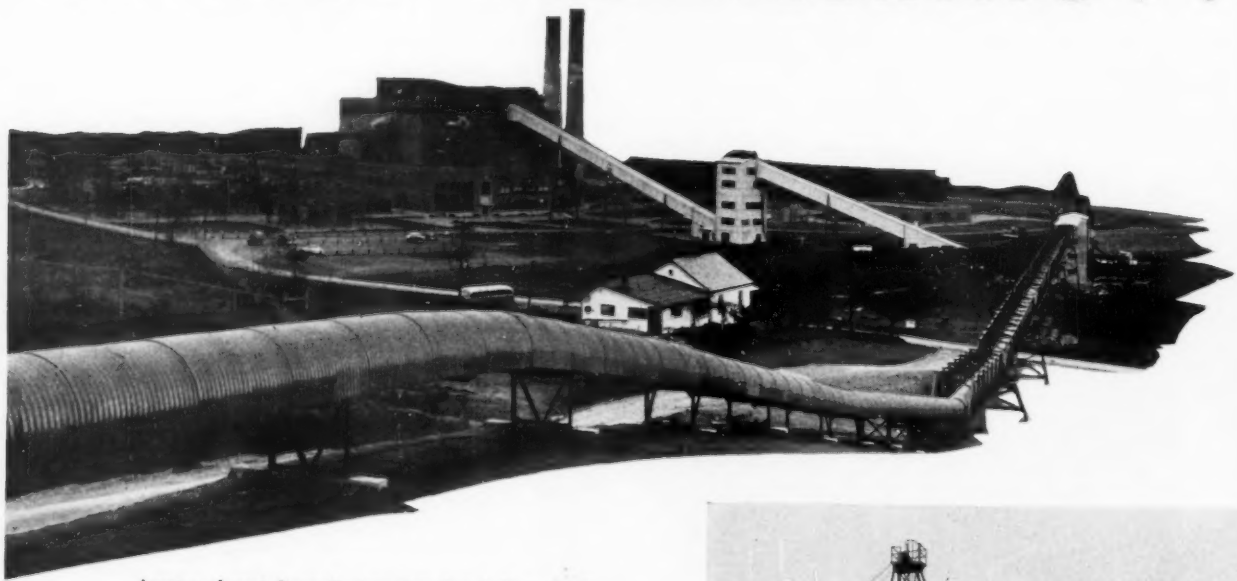
How You Can Solve Your Water Problems

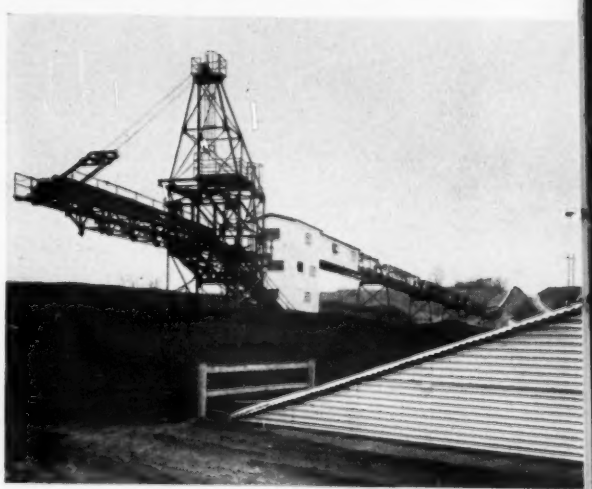
If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4190

ALLIS-CHALMERS

JEFFREY ENGINEERING . .





(center above) Overall view showing Jeffrey decline conveyor leading from transfer point to Jeffrey Boom Storage Conveyor.

(top left) Jeffrey No. 5150 Waytrol, at mine storage area, feeds coal at required rate and keeps automatic record of time and tonnage.

(top right) Decline conveyor leading down from transfer point. Note three-quarter covers for protection from sun and weather, open on lee side for easy and continuous inspection.

(right) Jeffrey Boom Storage Conveyor located to feed hopper over belt conveyors to power plant. Excess coal is moved to nearby ground storage.

300 tons an hour...570 feet per minute... at Columbus and Southern Ohio Electric Co. plant

The problem was to draw coal overland from a mine area 6,739 feet from the plant site of its Poston station. The road distance for truck or rail haulage was much longer.

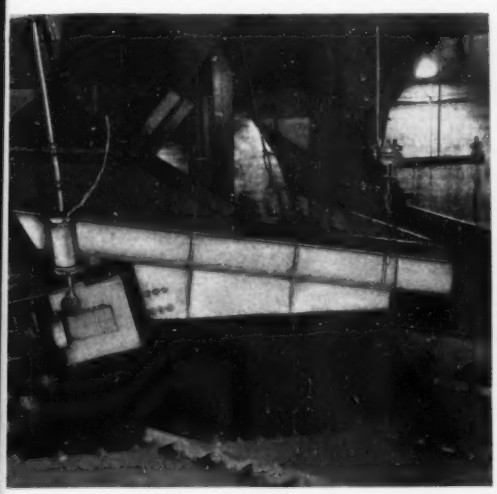
Careful studies indicated belt haulage by the direct route would be most economical. Jeffrey engineers were given the job of designing and installing what is believed to be the longest belt conveying system in the country using a 24" belt.

Coal for the Poston power plant now feeds in measured and weighed quantities from the mine supply by means of a Jeffrey Waytrol onto a 3,448 foot incline belt with a lift of 172 feet. This takes it to the transfer point where it starts a 3,291 foot decline to the plant. Both belts, 24" wide, carry 300 tons of coal an hour at 570 feet per minute over Jeffrey Reliance idlers.

At the discharge end a 36" Jeffrey Boom Storage Conveyor feeds the hopper. Two Jeffrey-Traylor Vibrating Feeders at the bottom of the hopper feed 300 tons an hour onto a 36" belt conveyor that rises to the crusher house. A 36" belt under the crusher carries the same 300 tons an hour into the plant to keep the big Poston bunkers continuously fed.

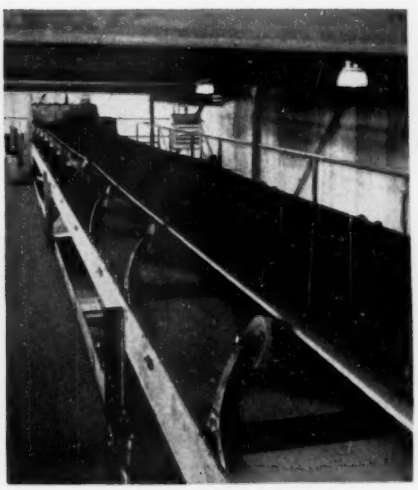
That's Jeffrey engineering . . . for the long haul, accurate weighing, the correct feed, and the proper size.

. . FOR THE LONG HAUL



Two Jeffrey-Traylor Vibrating Feeders at hopper bottom.

Jeffrey Crusher for reducing oversize coal to the desired stoker size.



Incline belt in gallery to Poston bunkers.

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

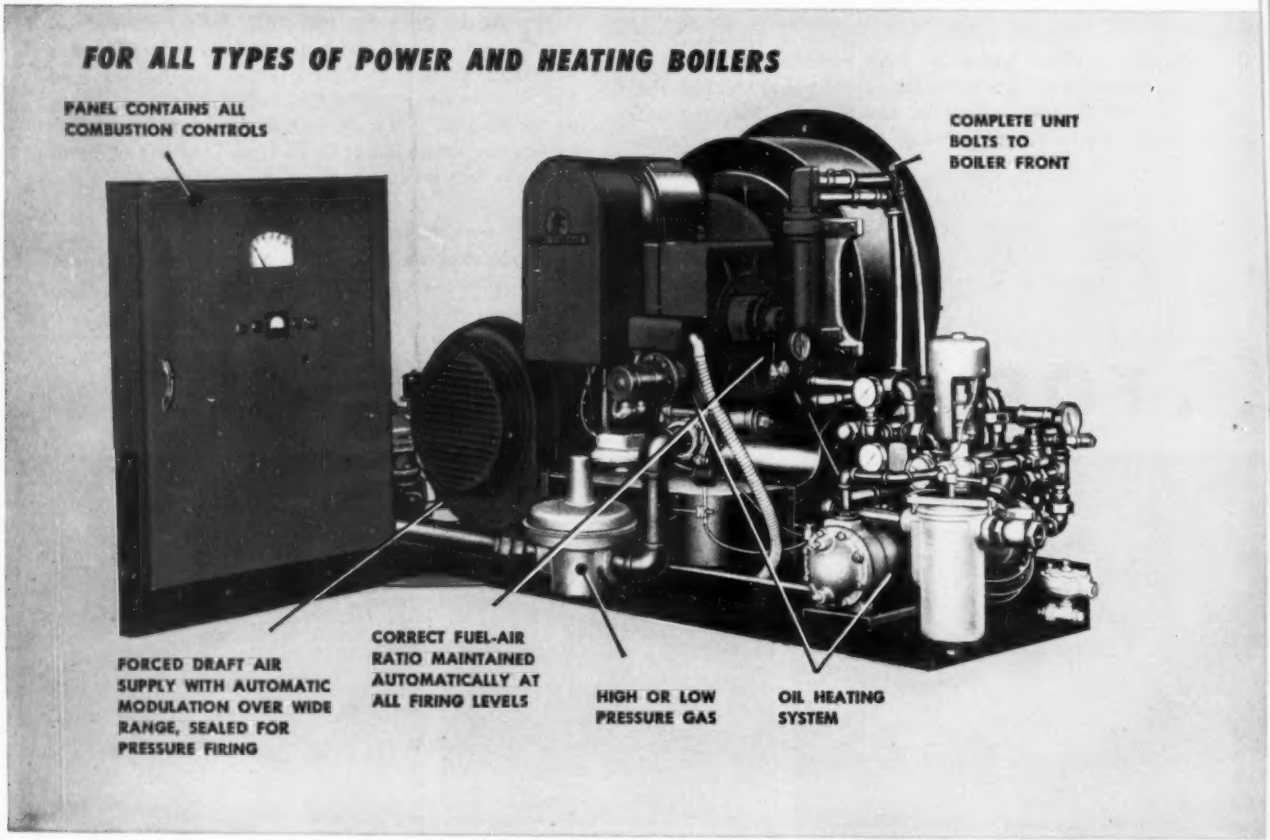
sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED

. . . IT'S A JOB FOR JEFFREY!

"Packaged" for better at lower cost IRON FIREMAN


FOR ALL TYPES OF POWER AND HEATING BOILERS
PANEL CONTAINS ALL COMBUSTION CONTROLS
COMPLETE UNIT BOLTS TO BOILER FRONT
FORCED DRAFT AIR SUPPLY WITH AUTOMATIC MODULATION OVER WIDE RANGE, SEALED FOR PRESSURE FIRING
CORRECT FUEL-AIR RATIO MAINTAINED AUTOMATICALLY AT ALL FIRING LEVELS
HIGH OR LOW PRESSURE GAS
OIL HEATING SYSTEM

Engineered as a single complete unit

This Iron Fireman package unit is much more than a conversion burner. It's a complete combustion system in which all elements are correctly balanced and integrated—a thoroughly engineered firing plant. It includes burner (for oil or gas or both), fuel system, forced draft air supply, control panel, and pre-formed refractory combustion throat. Installation requires little more than bolting the entire unit to the boiler front and making service connections for power and fuel.

To the user this means an attractive saving in installation time and cost. But even more important, it means a factory tested and assembled unit instead of a locally assembled job. It means dependable performance and high operating efficiency, with substantial fuel savings. It's the *smart* way to modernize your boiler room.

Get in touch with your Iron Fireman dealer, or mail the coupon on the opposite page for complete information.

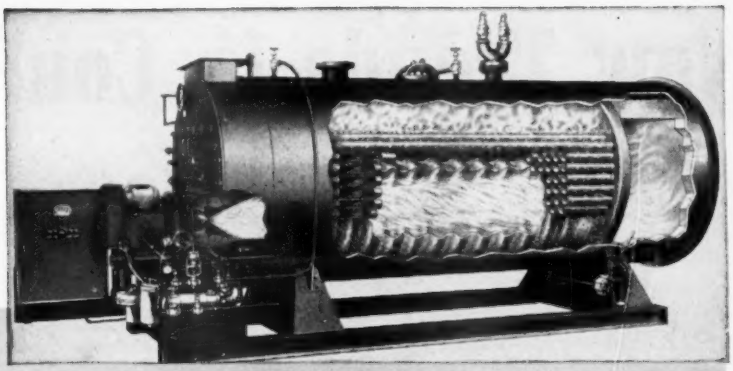
THE IRON FIREMAN

Iron

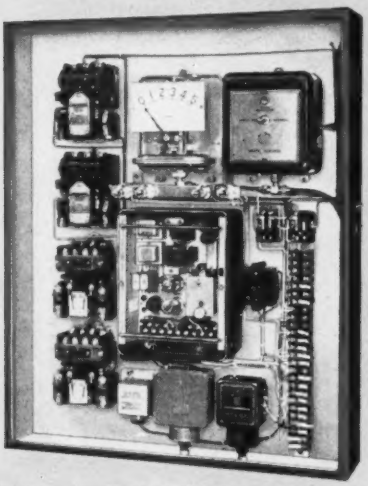
OIL, GAS AND COAL FIRING

firing

OIL, GAS or OIL-GAS COMBINATION BURNER UNIT

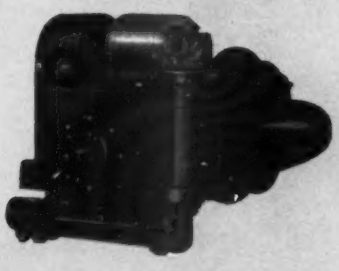


Cutaway view of packaged boiler-burner unit consisting of Scotch marine boiler with Iron Fireman combination Gas-oil forced draft burner. The shift from one fuel to another is accomplished quickly with no sacrifice in firing efficiency.



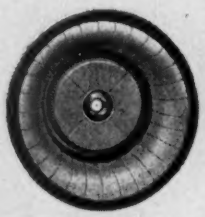
WIRED, TESTED CONTROL PANEL

Control panel is totally enclosed, with all instruments wired and tested at the factory. Entire wiring system is coded, with varicolored wires and numbered terminal strip inside panel. An indicating meter on the panel door shows the condition of the control system at all times. Indicating lights on panel front show operating status of unit at a glance. Green lights show motors in service; red indicates safety lockout.



IRON FIREMAN ROTARY OIL BURNER

The oil firing unit is the Iron Fireman rotary cup oil burner which has an outstanding record of reliability in precision firing of hard-to-handle heavy oils. Heart of the oil control system is the Iron Fireman Oil Volumeter, a variable volume metering pump submerged in the oil reservoir, which delivers the correct volume of oil to the burner head with extreme accuracy, regardless of changes in oil viscosity. Burns any grade of oil, from lightest to heaviest, without special adjustment.



REFRACTORY COMBUSTION THROAT

The combustion throat, with preformed built-in refractory, is an integral part of the burner unit. Both primary and secondary air are admitted to the combustion chamber through this throat, eliminating the special brickwork required by the usual conversion burner and greatly improving the air-fuel mixture. Oil cup is in the center of the refractory disc, which also shields the gas jets against the radiant heat of the furnace. Adjustable inlet vanes control the shape and rotation of the flame to match the requirements of the firebox or firetube.

QUICK CHECK ✓ POINTS

1. **Assembled and tested at factory instead of on the job.**
2. **Applicable to practically all types of boilers.**
3. **Continuous high combustion efficiency.**
4. **Forced draft; no high stack—requires only vent pipe.**
5. **For either gas or oil. Combination burner quickly shifted from one fuel to another.**
6. **Burns low-cost heavy oils (No. 6 or any lighter grade).**

Fireman

FOR HEATING, PROCESSING, POWER

Iron Fireman Mfg. Co., 3046 West 106th Street, Cleveland 11, Ohio. In Canada, write 80 Ward Street, Toronto, Ontario.

Please send me literature giving full information on the Iron Fireman "packaged burner" unit.

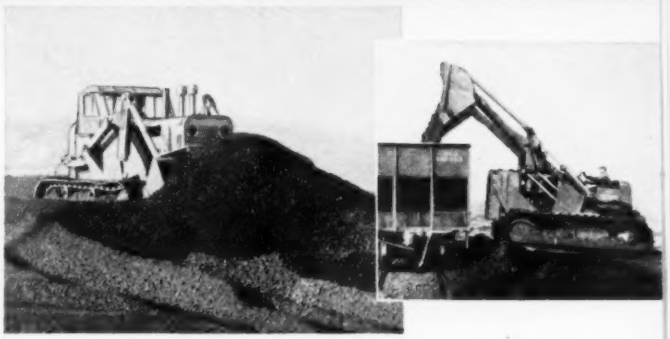
Name _____

Address _____

City _____ *State* _____

New Trends in Coal Handling

Store Coal 30 Tons at a Time. These two Allis-Chalmers HD-20 Torque Converter Tractors together move 30 to 36 tons of coal at a pass — dozing it out onto a stockpile at a southern power plant and compacting it at the same time to avoid fire by spontaneous combustion. Working as a team, the 41,000-lb. tractors move 15 to 30 percent more coal at a pass than they could both move separately. Two Allis-Chalmers units purchased in 1950 operated so successfully that the utility now has eight working at three plants.



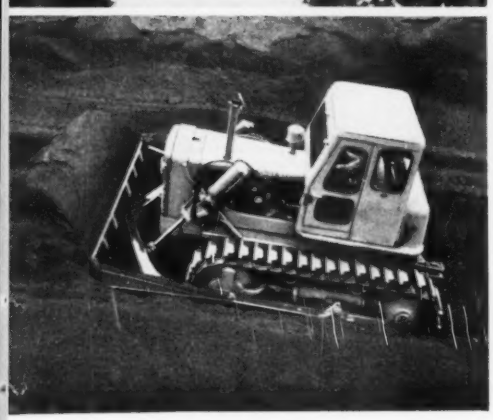
Tractor-Scraper Team Stockpiles Coal Anywhere. Coal brought in by water to Midwest chemical plant is economically hauled to stockpile, spread in 4-in. layers and compacted by Allis-Chalmers HD-20 Torque Converter Tractor and 25-yd. (18-ton) scraper. With tractor-scraper units that travel anywhere, storage areas can be placed wherever space is available, coal piled high if space is limited.

World's Largest Tractor-Shovel Pushes Coal or Loads It. *Above left,* Allis-Chalmers HD-20G with 7-yd. bucket is a big-production unit for moving coal to stockpile and then reclaiming it as needed. *Above right,* the HD-20G is a big-production loader, too. Its 5-ton capacity and 13-ft. dumping height make it ideal for loading hoppers, cars, biggest trucks.

New Special Coal-Handling Blade for HD-20 Torque Converter Tractor is designed to take full advantage of the tractor's big 175 net engine hp., permitting it to move about 15 percent more coal than with regular blade. The unit shown here stockpiling coal for a New York utility moves an average of 14 tons at a pass.

Motor Scrapers Move Coal Fast on Longer Hauls. With 4th-gear speed of 22.5 mph. and heaped capacity of 18 yd. (13½ tons), the Allis-Chalmers TS-300 Motor Scraper efficiently moves big quantities of coal long distances. It compacts well, too, with 47,900 lb. total weight. Has 20 hp. per cu. yd. capacity for bigger loads every trip. The TS-200 Motor Scraper has a heaped capacity of 13 yd. (10 tons).

Flexibility in Tractor Handling of Coal is shown by versatile Allis-Chalmers units. They can either handle all storing and reclaiming of coal—or supplement existing facilities. Storage areas can be added without installing costly conveyors, tracks, etc.—or abandoned without leaving money tied up in idle equipment. The 109-drawbar-hp., 27,850-lb. HD-15 Tractor seen here easily takes care of all storing and reclaiming of coal for an eastern power plant.



HD-9 Tractor Handles Coke for Steel Mill. An Allis-Chalmers 72-drawbar-hp., 18,800-lb. HD-9 Tractor dozes coke out onto stockpile, levels and compacts it, then reclaims it as needed by the plant. Freezing of coke surface in wintertime no longer hinders operation with tractors as it did with previous system.

cuts equipment investment, speeds work with versatile HD-5G Tractor-Shovel

Stockpiles. Allis-Chalmers 40-drawbar-hp. HD-5G Tractor-Shovel pushes coal wherever desired on stockpile at Midwest plant. Also stockpiles cinders.

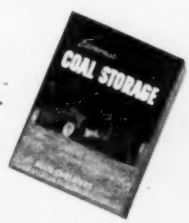
Compacts. With added weight of full loaded bucket, 16,200-lb. HD-5G compacts coal for safety from fire.

Reclaims, Loads. With 2-yd. (1½-ton) bucket and 9-ft. dumping height, the HD-5G efficiently loads coal from stockpile to trucks for hauling to plant. Dozes or carries coal on short hauls. Owner supplies cinders to concrete contractors, finds handling them with HD-5G faster and lower cost than the power shovel formerly used for this purpose.

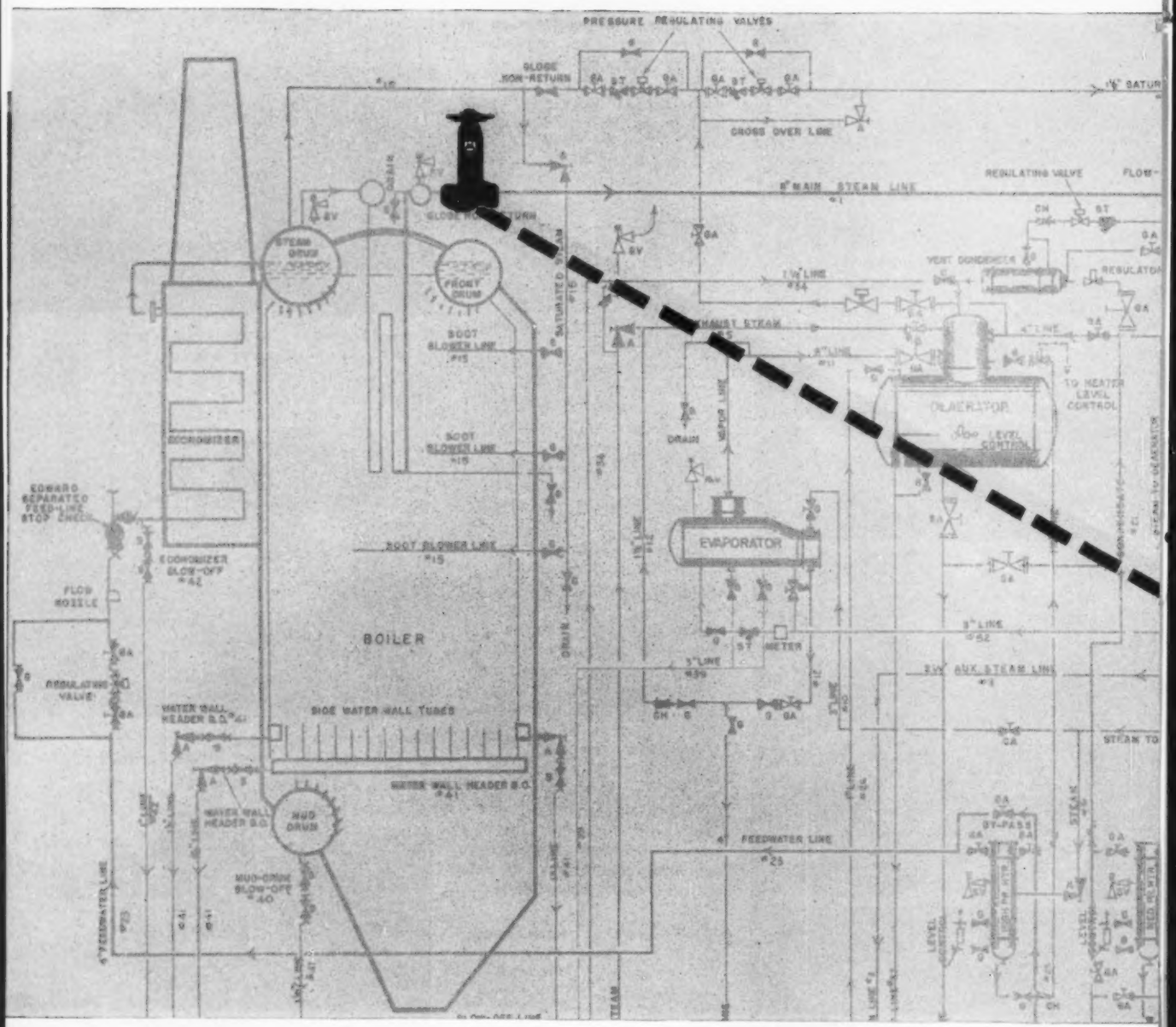
ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

4 TRACTORS • 4 TRACTOR-SHOVELS • 7 SCRAPERS • 2 MOTOR SCRAPERS
2 MOTOR WAGONS • 5 MOTOR GRADERS

Find out more about how Allis-Chalmers equipment can improve coal handling for you. See your Allis-Chalmers dealer for a demonstration right at your plant. Also, send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors."



What you should know about



Essential to boiler safety is a non-return valve, required to prevent flow of steam from the main header into a boiler which is temporarily below header pressure. Edward non-return valves are installed on an overwhelming majority of the nation's principal power plant boilers.

BOILER CODE REQUIREMENTS

When two or more boilers are connected to a common header, the steam connection from each boiler must be fitted with two stop valves, preferably consisting of one automatic non-return valve set next to the boiler and a second valve of the outside screw and yoke type.

The non-return valve must be rated:

1 At 100% of the set pressure of the drum safety valve at the corresponding saturated steam temperature.

2 At 100% of the minimum set pressure of the super heater safety valve at the super heated steam temperature.

3 At 85% of the lowest set pressure of the boiler drum safety valve at the expected temperature at the super heater outlet.

Reference P 302, P 303, Rules for Construction of Power Boilers, 1952.

INSTALLATION POINTERS

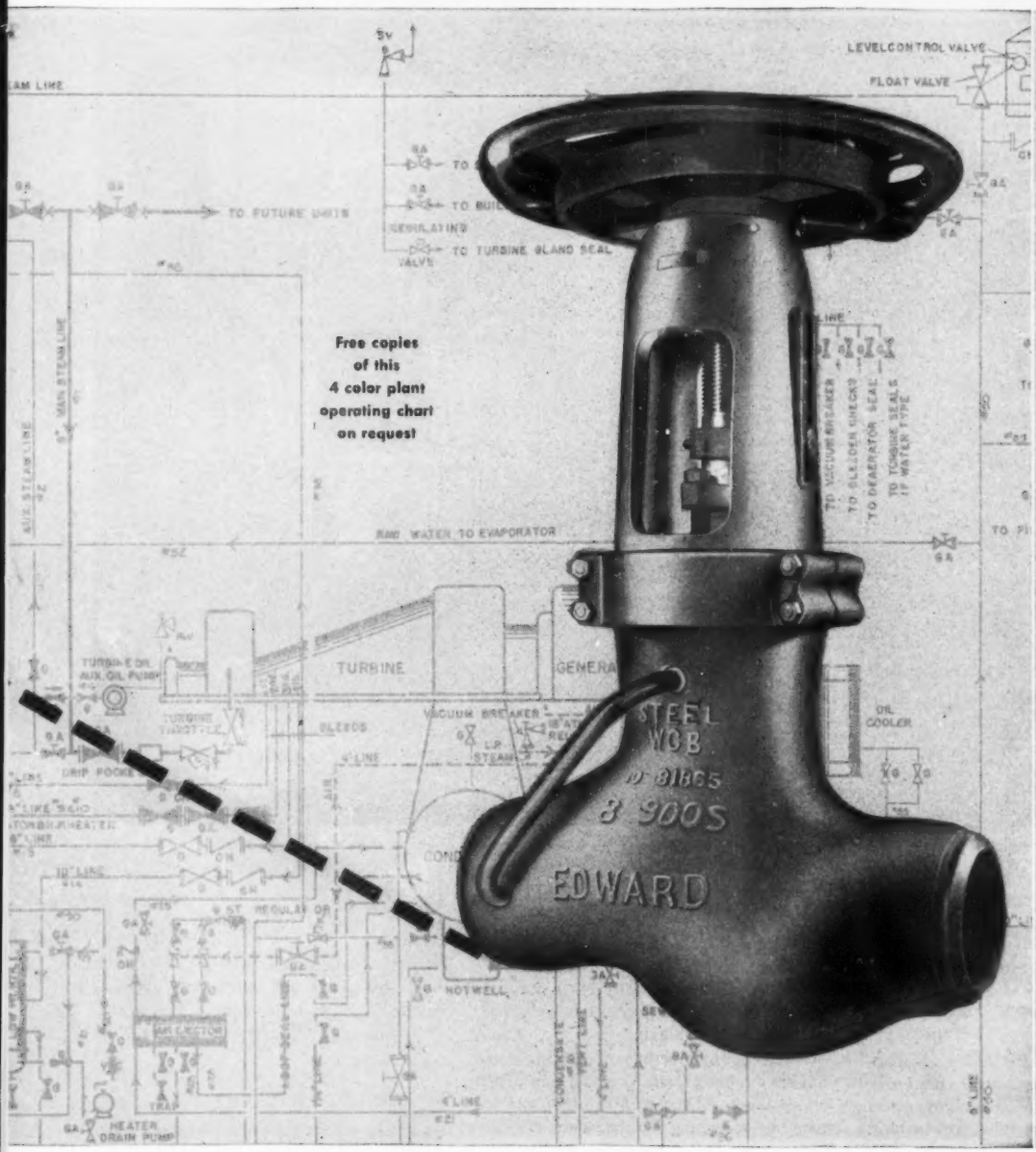
The non-return valve should be installed:

1 So that it can be readily manipulated by hand as a stop valve.

2 So that the disk piston is in a vertical plane. Avoid installations where the disk piston travels on an angle, thus providing the possibility of hang-ups and incomplete closure.

3 With an Equalizer, where operating conditions require wide variations in flow rates. The Equalizer, a piping connection between the high pressure area over the disk piston and the low pressure, high velocity outlet, causes the disk piston to be sucked up into the bonnet chamber, which gives it a firm support and provides vibrationless operation. The flow passages in the valve are left wide open for minimum pressure drop.

NON-RETURN VALVES*



4 On the boiler lead just after the superheater safety valve. An Edward gate valve is recommended as the second stop valve required by the boiler code which also stipulates that a drain must be installed between the two valves so that its discharge is visible while the operator is manipulating the valve.

SELECTION POINTERS

Be sure your non-return valve has:

1 A simple uncomplicated design—avoid gadgety constructions and involved mechanisms which can cause trouble and fail in operation.

2 A closing mechanism which insures drop tight closing at boiler test pressures. A great asset here is the Edward Impactor Handwheel which allows an operator to apply 2.8 times the closing force of ordinary handwheels.

3 Forged stainless steel piston rings. Insistence on forged rings will eliminate disassembling of valve to remove pieces of broken piston rings from the flow passages.

4 Body contours which have been specifically designed and tested for minimum pressure drop.

5 Integrally cast mirror smooth guide ribs, which govern the path of the disk piston during its entire travel. Stem guided disk pistons may cause faulty alignment during the last stages of travel, the most critical part.

6 Light weight disk piston of hourglass design for maximum piston lift and low pressure drop.

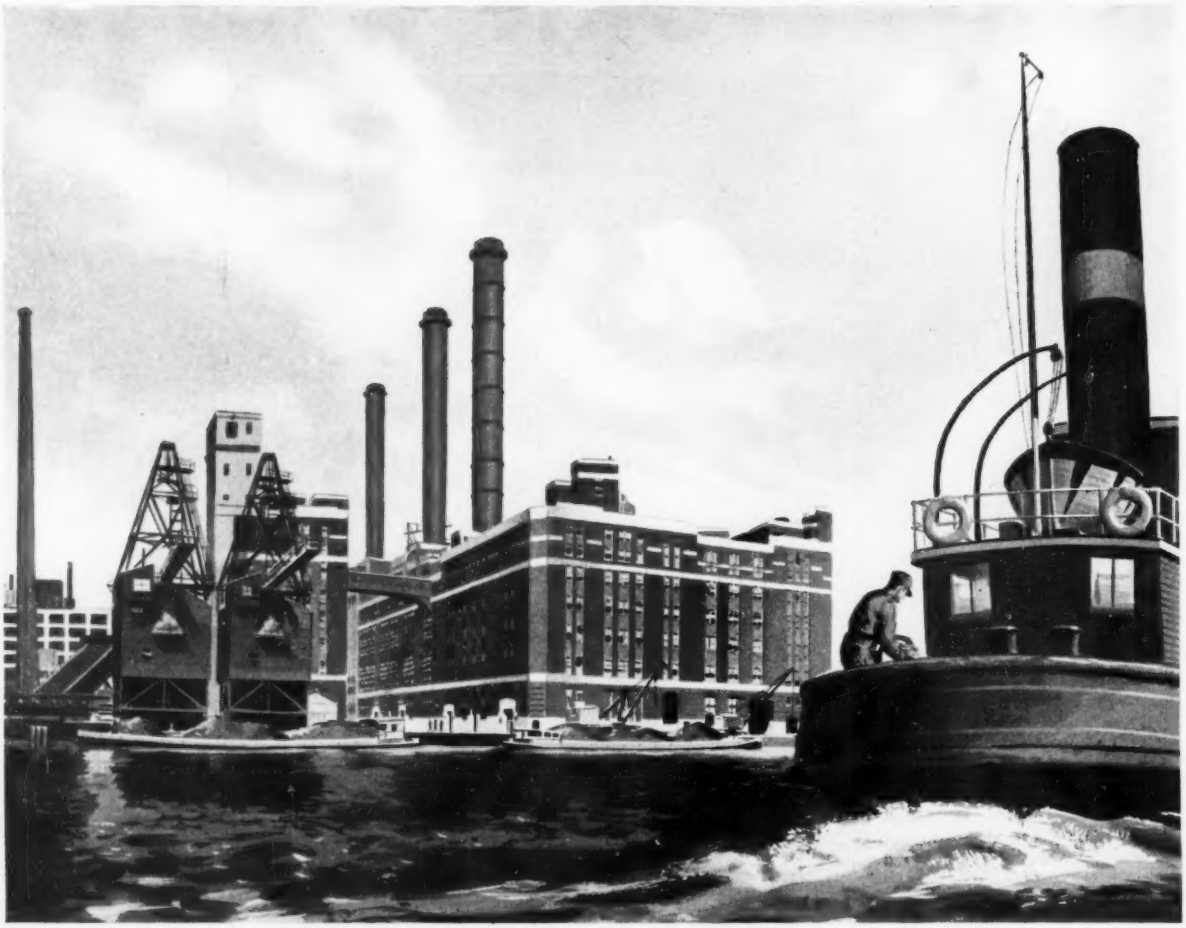
For complete information on non-return valves write for a copy of catalog 12-B to Department NR, Edward Valves, 1220 West 144th St., East Chicago, Indiana.

*One of a series providing condensed information on valve applications in steam power plants.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA Another Product



East River to get big new job

The scene is Consolidated Edison Company's expanded steam-electric generating plant along New York City's lower East River.

Here, in the near future, will be installed the world's largest single-shell condenser —a house-sized Worthington apparatus that will enable a powerful steam-turbine generator to produce as much as 30% more electricity than would be possible without it. Inside the giant unit are a total of 105 miles of 30-foot aluminum-brass tubes through which cooling East River water will travel at the rate of 138,000 gallons every minute.

While converting steam to water, the condenser removes in an hour enough heat to supply the entire daily hot-water requirements for all the families in a city the size of Flint, Michigan.

Worthington first began building condensers in 1840, just 70 odd years after James Watt constructed the first one to raise the efficiency of his steam engine. Today, they're just one of the many kinds of apparatus Worthington makes for those great electric utility companies that are constantly working to make possible a more productive America.

Similar Worthington pioneering in the design and production of other kinds of equipment has led to the manufacture of 14 major product lines for widely diversified industrial and commercial markets in the U. S. and throughout the world. Worthington Corporation, Harrison, N.J.

WORTHINGTON

The Sign of Value Around the World

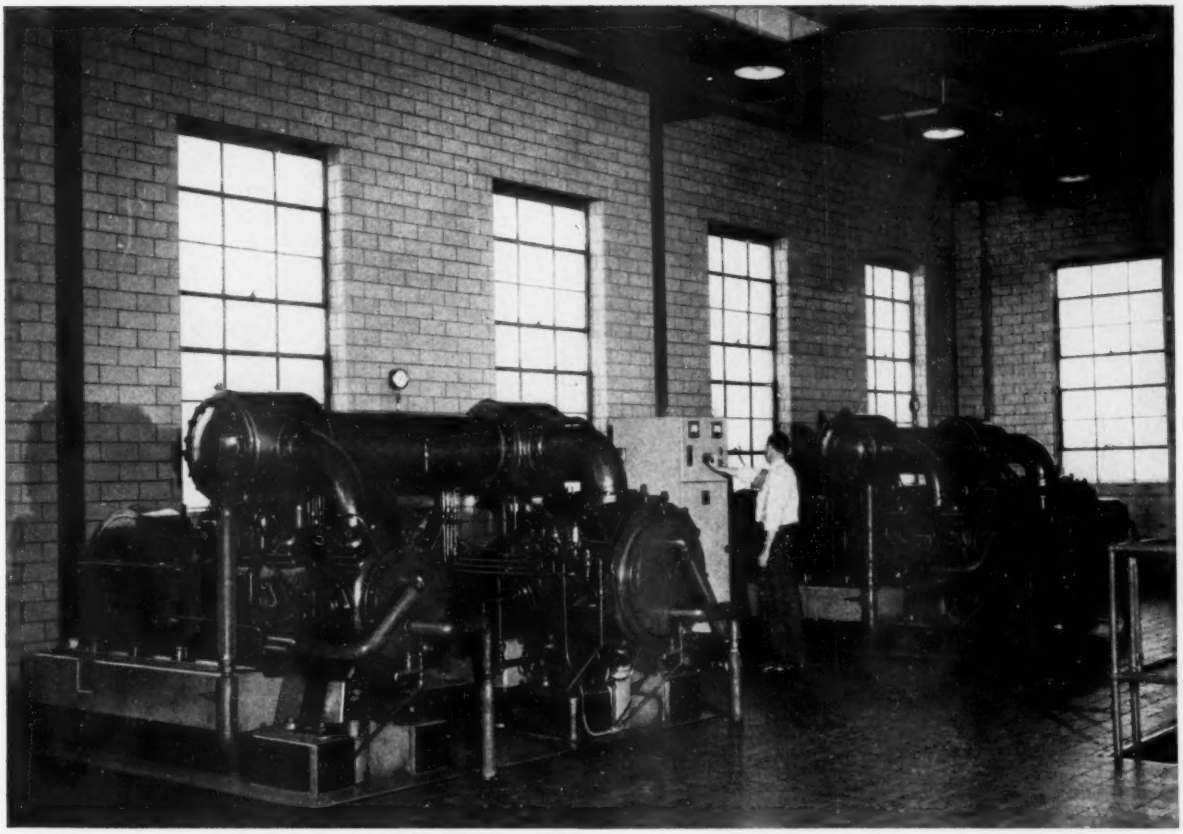
2.11

Efficient Power—water treating · steam condensers · feedwater heaters · pumps engine and turbine generators

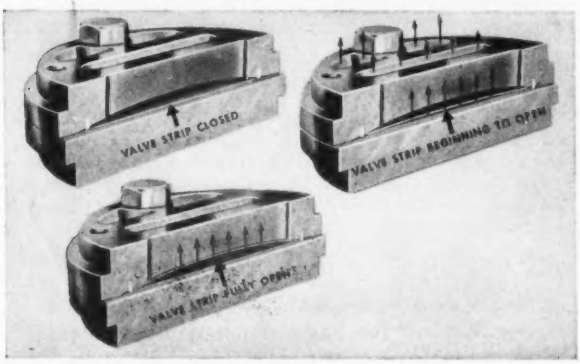
Better Roads and Construction — Blue Brute air compressors · mixers pavers · air tools · pumps

Petroleum Products — compressors engines · pumps · chilling equipment refrigeration · decoking systems · turbines

Good Water and Sanitation — engines pumps · water treating · comminutors air compressors · air tools · water meters



PERFECTION STOVE'S ULTRA-MODERN POWER PLANT is equipped with two Worthington DC-2 air compressors, each with a capacity of 1000 cfm.



QUIET-OPERATING WORTHINGTON FEATHER* VALVE is made up of a series of thin flexible strips of ribbon steel, held in position over rectangular openings by curved milled guards. The valve strips lift and flex uniformly against the curved guards. In addition to quiet operation, the absence of impact results in long valve life and low maintenance costs.

Perfection called for the finest in air compressors

• The Perfection Stove Company's new Ivanhoe Road power house in Cleveland has received national recognition as a leading example of modern, medium-size power plant design.

Every piece of equipment in this million-dollar plant had to meet the rigid specifications of Perfection's engineers. That's why, when it came time to supply compressed air for general plant use, two Worthington DC-2 horizontal air compressors were selected.

By installing these modern Worthington compressors, Perfection engineers made sure they would get lowest-cost compressed air and longest compressor life. The exclusive Worthington Feather* Valve—the lightest, tightest, most efficient valve made—is largely responsible for that.

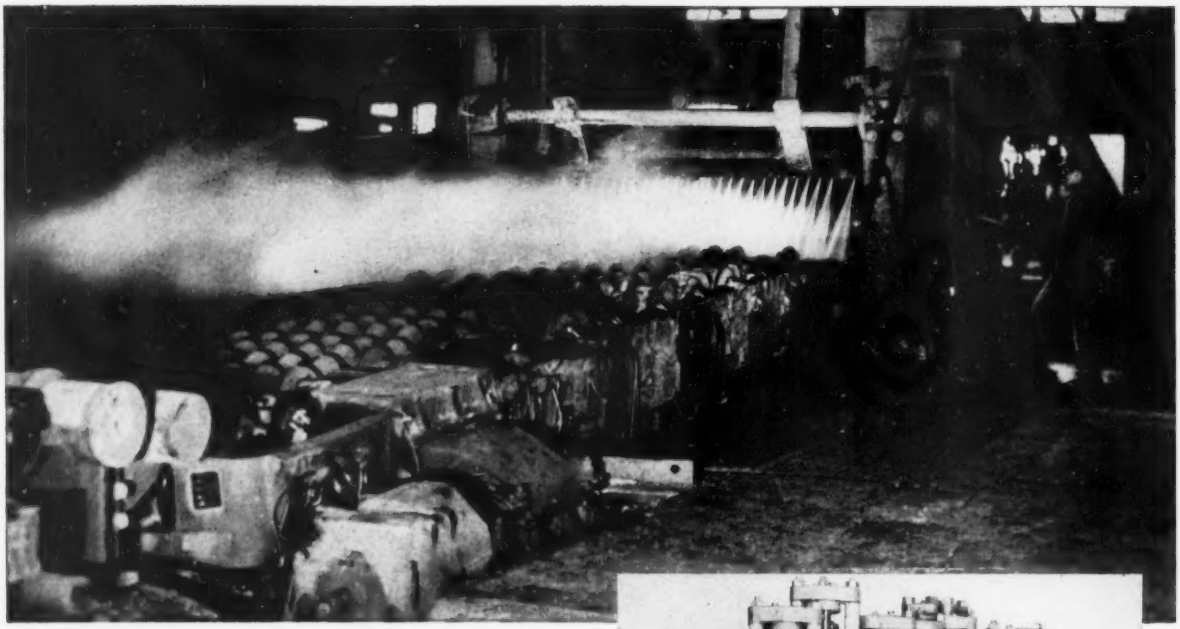
Take a tip from Perfection Stove and find out for yourself about the Worthington line of air compressors. Write to Worthington Corporation, Compressor Division, Section K.3.7, Buffalo, N. Y. **Reg. U. S. Pat. Off.*

K.3.7

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors



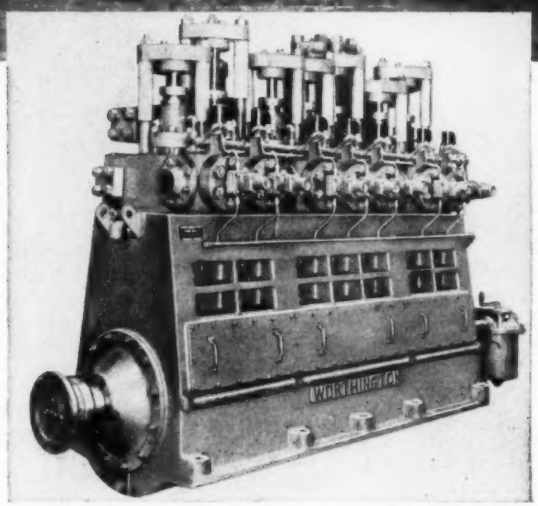
High-pressure water descales thousands of tons of steel daily

It takes vast quantities of high-pressure water to remove the scale from steel sheets, plates and billets going through rolling mills like the one shown above.

To deliver high-pressure water for this kind of work, more and more leading names in industry are specifying Worthington heavy-duty multi-plunger power pumps. Here are some of the reasons why:

Worthington's patented synchronized suction-valve unloading allows delivery to start or stop as often as you want, quickly but gradually, without any shock or disturbance.

Ceramic plungers, optional on all of Worthington's power pumps, are precision-made for complete and easy interchangeability. As hard as tungsten carbide, these plungers resist corrosion, abrasion and breakage.



WORTHINGTON HEAVY-DUTY MULTI-PLUNGER POWER PUMPS deliver high-pressure water for use in hydraulic descaling system in this rolling mill. These rugged pumps are also used in hydraulic press work, foundry cleaning systems, hydrostatic testing and high-pressure process pumping.

Individual valve-hole covers permit quick and easy access for valve maintenance without disturbing piping.

Get all the facts about these dependable, long-lived pumps. Write for the free Power Pump Bulletin, W-415-B1, to Worthington Corporation, Reciprocating Pump Division, Harrison, N. J.

P.3.6

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

Power Pumps

HEATING
COOLING
CONDENSING
EVAPORATING

Superior Heat Exchangers

are widely used to condense oil refinery vapors; to recover volatile solvents; to liquefy gases; to sub-cool boiler condensate; and for desuperheating. Customed to individual operations for either pressure or vacuum service, their design provides a minimum of pressure drop, prevents impingement, and minimizes stagnant areas.

Superior's complete design and manufacturing facilities are geared to handle the most unusual as well as the more conventional requirements.

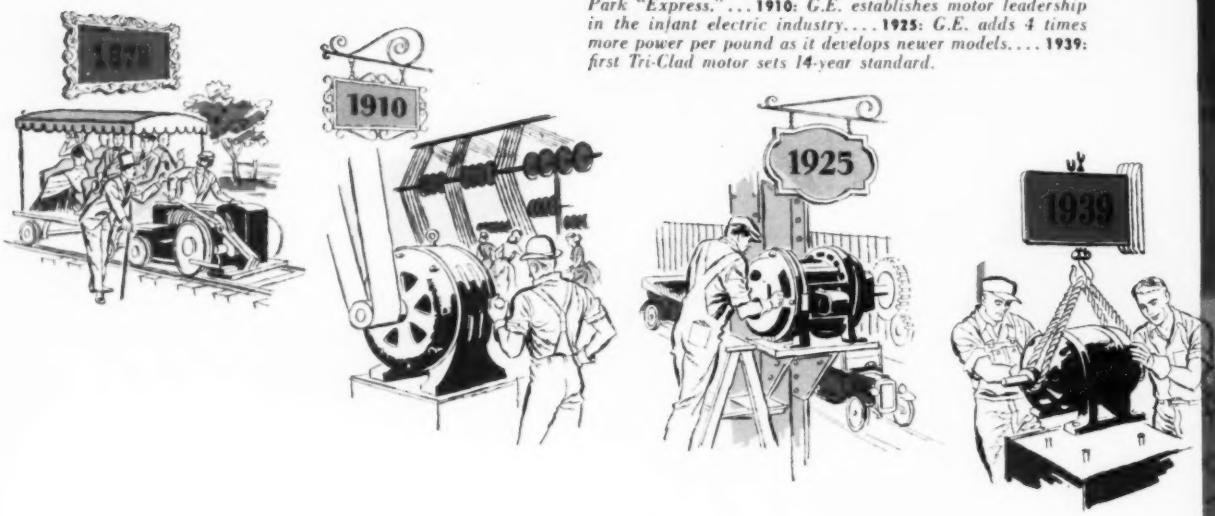
Our Engineering Department invites your inquiry on any proposed application as a basis for a specific engineering recommendation. Write for catalog 5010.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
HEAT EXCHANGERS

1878: *Thomas Edison builds an electric motor for his Menlo Park "Express."* ... **1910:** *G.E. establishes motor leadership in the infant electric industry.*... **1925:** *G.E. adds 4 times more power per pound as it develops newer models.*... **1939:** *first Tri-Clad motor sets 14-year standard.*



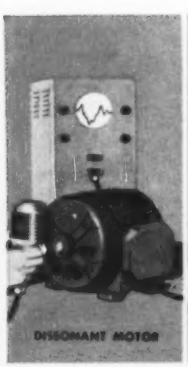
General Electric Announces...

A NEW MILESTONE IN MOTOR HISTORY

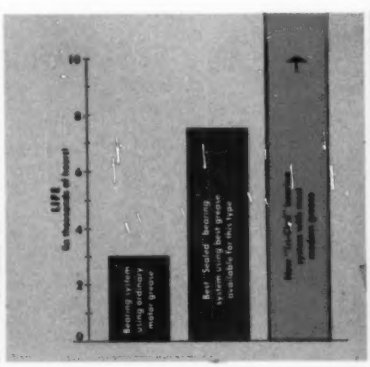
New TRI 55 CLAD motor climaxes 75 years of engineering leadership

The General Electric Tri/Clad '55' is an important milestone in motor history. For this is a *completely new motor.* Born out of thousands of engineering man-hours, the Tri/Clad '55' incorporates design improvements that go far beyond mere modifications. Many years of pure research, the discovery of new, better materials, the knowledge of how to make better use of present materials, and improved manufacturing processes all make the Tri/Clad '55' motor the new leader in the motor field.

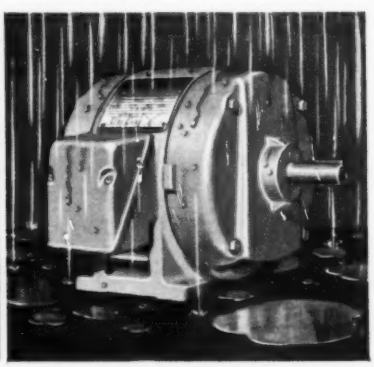
You as a motor user should take the opportunity to see and test this motor for yourself. Contact your nearest G.E. Apparatus Sales Office or G.E. Motor Agent and tell him you want to see the new G-E Tri/Clad '55'. General Electric Company, Schenectady 5, N. Y. 648-4



DESIGNED FOR BETTER PERFORMANCE: Tri/Clad '55' has a low noise level . . . runs cool . . . gives up to 53% increase in shaft output per pound...has higher full-load speeds.

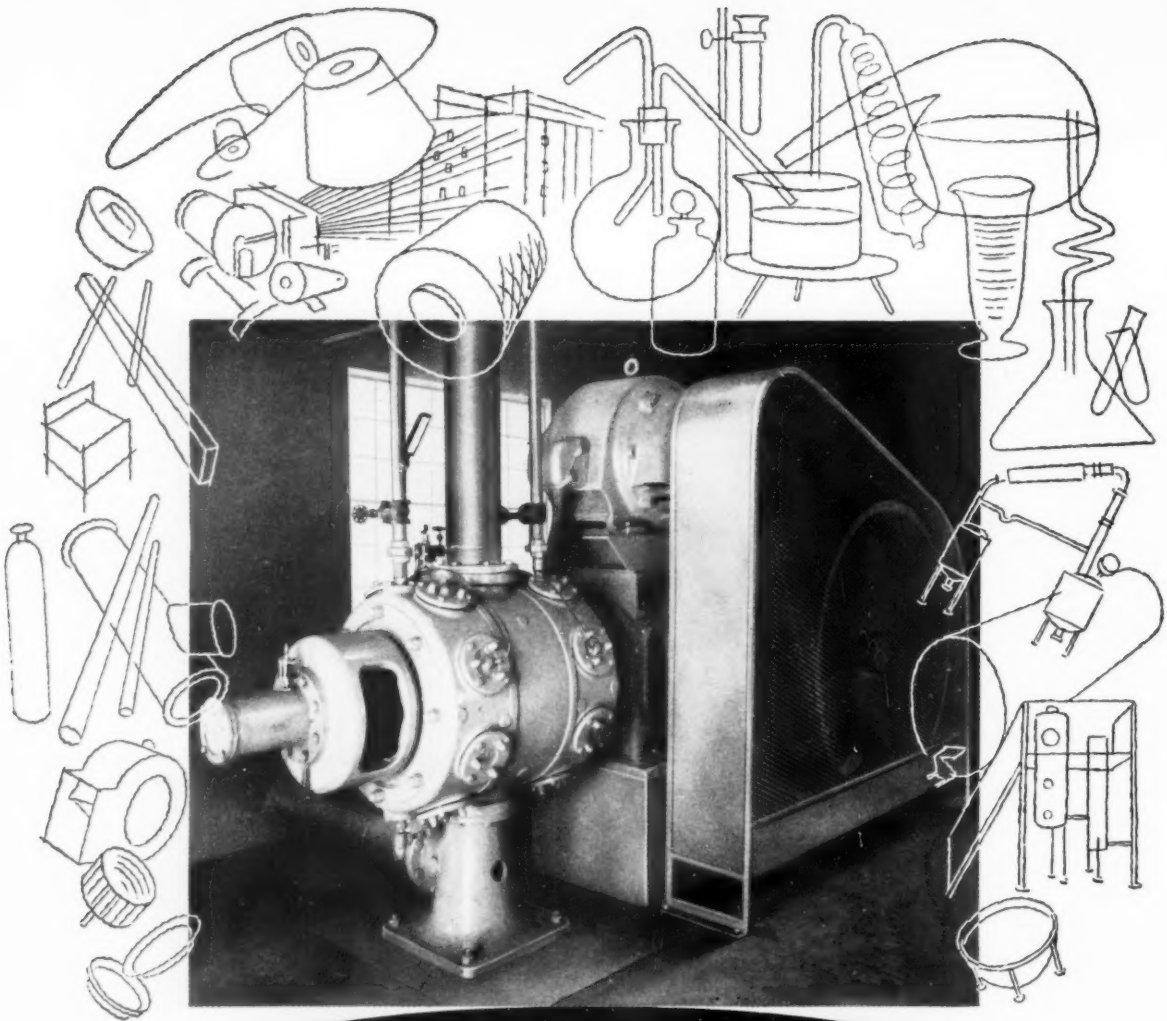


ENGINEERED FOR LESS MAINTENANCE: 10%-life tests (such as the one shown) prove the Tri/Clad '55' bearings last longer without regreasing than any other bearing system.



BUILT TO LAST LONGER: cast-iron strength . . . more fully enclosed dripproof construction . . . water-shedding stator windings . . . polyester film insulation 8 times stronger.

GENERAL ELECTRIC
TRI 55 CLAD INDUCTION MOTOR
MODEL
SER NO
HP
FL RPM
VOLTS
PHASE
CYCLES
FL AMP
TYPE
CODE
FRAME
TIME RATING
C RISE
TRI 55 CLAD
THE LEADER IN MODERN MOTOR DESIGN
Progress is our most important product
GENERAL ELECTRIC



Protect Products

WITH CP OIL-LESS CYLINDER COMPRESSORS

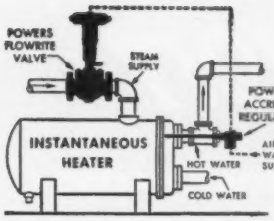
If you use air for operating instruments or if you process chemicals, beer, food or other products where oil-laden air would be a detriment, you need a Chicago Pneumatic Oil-Less Cylinder Compressor.

Available in three types, CP Oil-Less Compressors have carbon piston rings — need no oil or other lubricant. The Class T-BO illustrated above has a full-floating piston with an outboard crosshead. Piston weight is not carried by the cylinder wall or the carbon rings — rings act only as a compression seal against the hardened steel cylinder liner. A distance piece between cylinder and frame, and carbon piston rod packing prevent transmission of oil into the cylinder from the frame.

For more details, write for Bulletin 728 Supplement D.

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

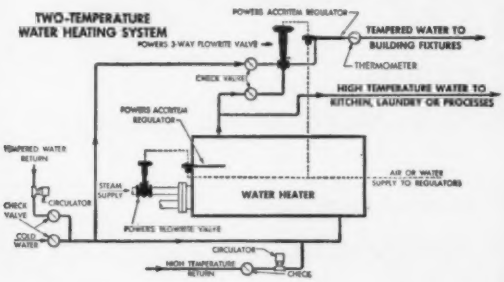
PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

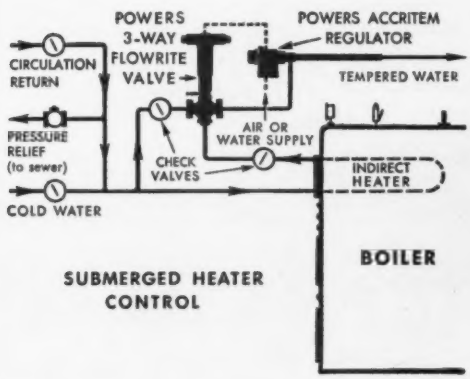


POWERS

ACCRITEM REGULATOR

Only a few of many uses





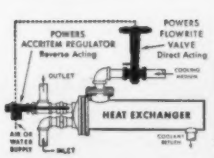
Gives

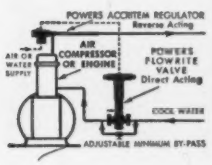
Accurate, Low Cost Heat Control

Use Accritem Regulators to control diaphragm operated valves or dampers. They save labor, stop losses caused by over-heating and have the following —

IMPORTANT ADVANTAGES

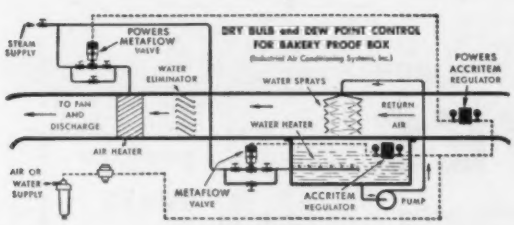
- ***Adjustable Sensitivity*** and over-heat protection.
- ***Calibrated Dial*** temperature adjustment.
- ***Simple, Rugged Construction*** withstands vibration and insures many years of reliable service.
- ***Temperature Ranges*** 50 to 250° F. and 150 to 350° F.
- ***Easy to Install*** Requires 15 lb. supply of compressed air or water for its operation.
- ***Small Size*** — regulator head is only 2⅞" x 3⅝", sensitive bulb is 12" long with ½" I.P.S. connection.





POWERS

FLOWRITE and METAFLOW
Diaphragm Valves
controlled by a POWERS
ACCRITEM HEAT REGULATOR
provide an unbeatable combination for *better control and lower maintenance*



Write for Bulletin 316—or phone our nearest office for prices and further information about POWERS ACCRITEM regulators and diaphragm valves.

THE POWERS REGULATOR CO.

OFFICES IN OVER 50 CITIES • See Your Phone Book

Factory & General Offices: SKOKIE, ILLINOIS

CHICAGO 13, ILL., 3819 N. Ashland Ave. • NEW YORK 17, N. Y., 231 E. 46th St.

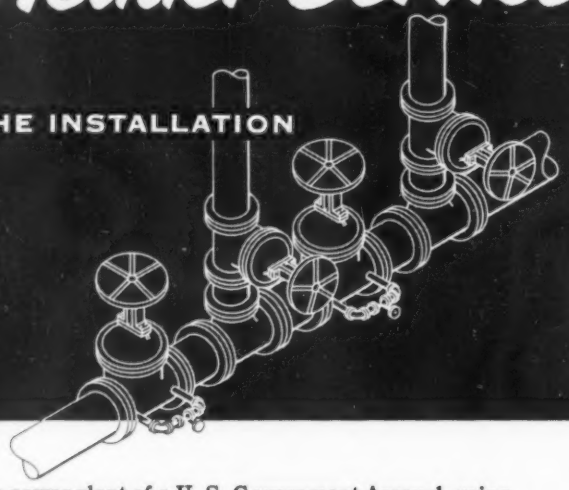
LOS ANGELES 5, CAL., 1808 West 8th St. • TORONTO, ONT., 195 Spadina Ave.

(AMH)

Over 60 Years of Temperature and Humidity Control

Holding Tight Since 1917 On Boiler Header Service

THE INSTALLATION



In power plant of a U. S. Government Arsenal, using Crane 14-inch 300-pound steel gate valves in main steam header operating at 135 pounds, 380 degrees F.

VALVE SERVICE RATINGS

SUITABILITY: *No failure in 36 years*

FEATURES: *100% heavy duty design*

MAINTENANCE COST: *No repairs to date*

SERVICE LIFE: *Installed 1917 – still O.K.*

OPERATING RESULT: *Increased plant efficiency*

AVAILABILITY: *Crane catalog item – Current No. 33XR*

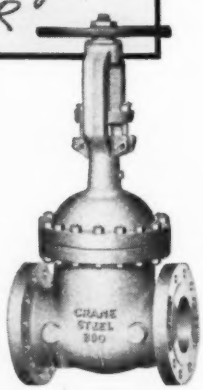
THE CASE HISTORY

Installed in 1917, these Crane valves have given completely satisfactory service for 36 years without needing repairs of any kind. Inspected in 1951, they showed no undue wear in any part, and a 125-pound hydrostatic test found them absolutely tight. Right back into the header they went, where they're still giving like-new service.

In a period of plant expansion, other makes of valves were tried in the same header service. But those valves gave constant trouble, whereas when replaced with Crane valves, satisfactory results were obtained.

Here's an example of the confidence you can put in a name that traditionally means better quality. For what good is a price without the assurance of product dependability and good value. You're safer—always—when you choose Crane.

THE VALVE



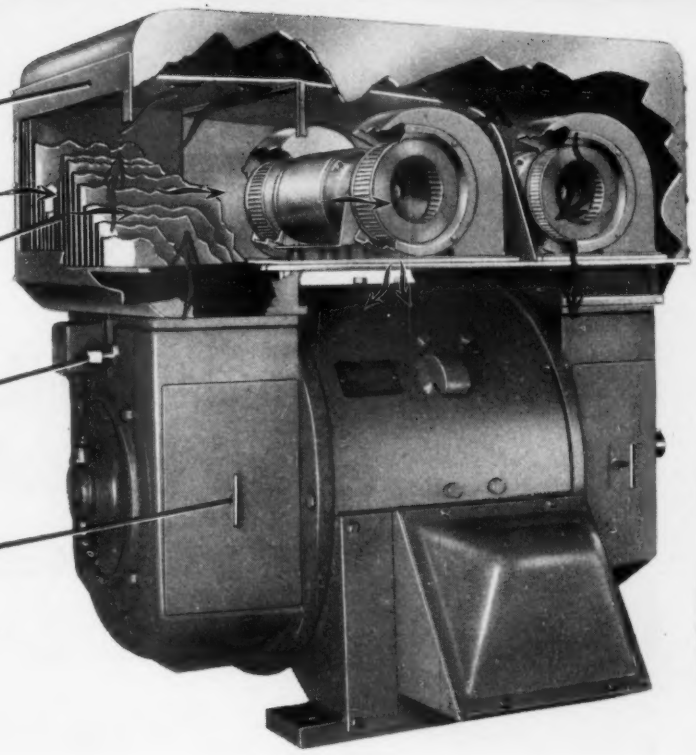
Here is steel casting skill at its best, by the pioneer in steel valves. Here also is leadership in design and manufacturing that sets Crane Steel Valves apart from the ordinary. Choose these valves for your specific needs from the widest range of body and trim materials, in all pressure classes and sizes, with flanged, screwed, or welding ends. See your Crane Catalog.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



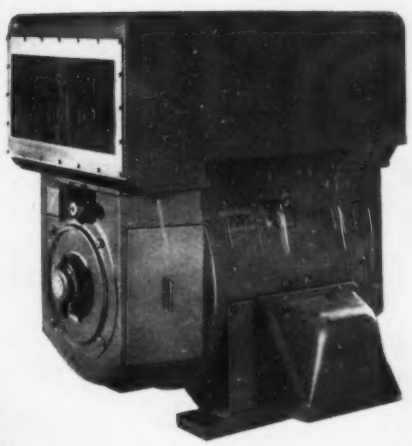
COMPACT, top-mounted cooling unit falls within the over-all length and width of main motor.

SMOOTH vertical plates are self-cleaning. Cooling unit is easy to remove for inspection.

PROTECTIVE THERMOSTAT helps safeguard main motor in case of blower-motor power failure.

EASY ACCESS to inspection opening—no tools required.

General Electric Announces New Unit-Cooled D-C Motor!



THE SMOOTH STYLING of the new unit-cooled motor is in harmony with good machine design. Smooth contours facilitate cleaning. No ducts or piping are needed on this compact, ready-to-install unit.

Smallest of type from 15-200 hp, new motor features 50% greater heat transfer in 37% smaller unit than previous design.

To meet your industry's need for a compact, totally enclosed motor, this new General Electric unit-cooled design features more effective heat transfer in a smaller unit.

Special construction assures dependable operation, with minimum maintenance, in the severe atmospheres which make open or partially enclosed motors difficult to maintain.

Shutdowns for cleaning and inspection are reduced to a minimum. Air-borne contaminants and foreign particles are kept out of the internal ventilating air by the totally enclosed construction

For additional information on ratings and dimensions, contact your nearest General Electric office or write for Bulletin GEA-6091, "Unit-cooled D-C Motors." Address Section 770-31, General Electric Company, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

Announcing Foster Wheeler's new

completely tooled to effectively meet your most exacting needs for steam generators, heat-transfer and process equipment!

---

1. 8000 TON BEAM PRESS
Hydraulically operated, will bend steel plates 40' long, 8" thick.

2. PLATE EDGE PLANER
Will take the longest available plates, for cutting welding grooves.

3. OVERHEAD CRANES
Four large cranes capable of lifting the heaviest and largest equipment easily.

4. DOUBLE HOUSING PLANER
Highest speed planing.

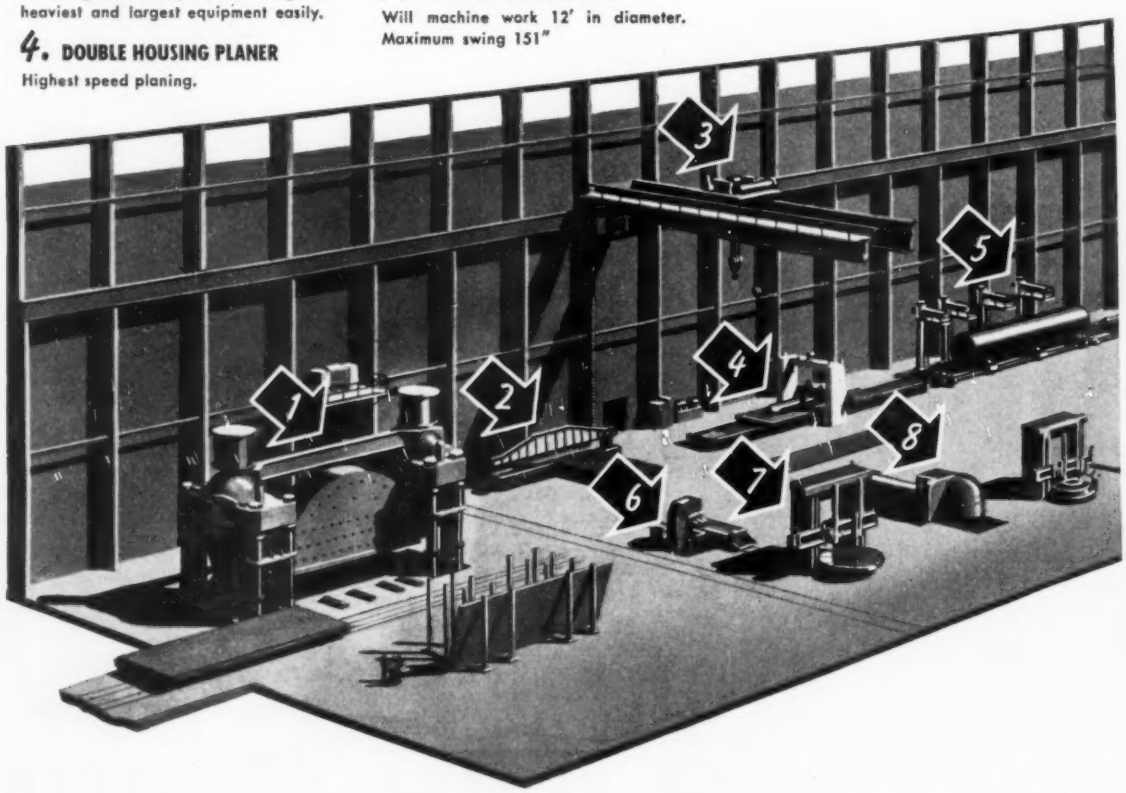
5. AUTOMATIC WELDING MACHINES
Submerged-arc, automatic flux recovery-type, mounted on track.

6. 500 TON CRIMPING PRESS
For cold-bending edge of plate preparatory to rolling.

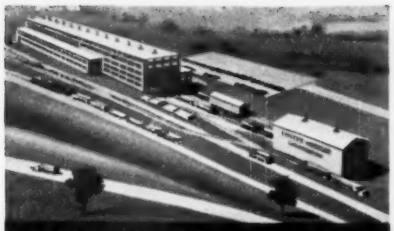
7. VERTICAL BORING MILL
Will machine work 12' in diameter. Maximum swing 151"

8. BENDING ROLLS—PINCH TYPE
By hot or cold rolling will form cylinders for medium-pressure vessels.

9. HIGHEST SPEED DRILLS—RADIAL TYPE
These are mounted on ways and tracks, power positioned.



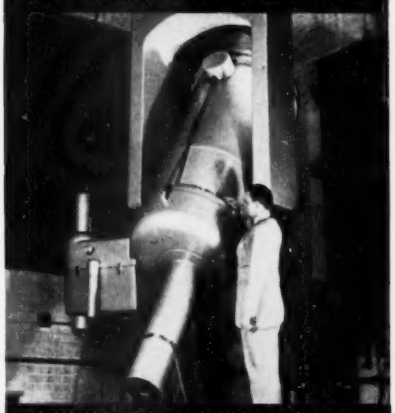
Mountain Top plant...



Artist's drawing of Foster Wheeler's new Mountain Top plant near Wilkes-Barre, Pa.

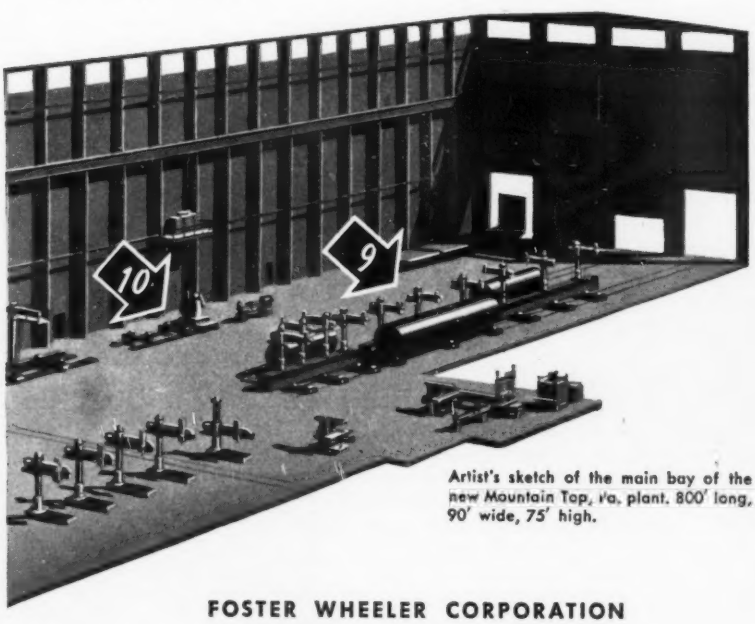
ANTICIPATING your requirements for more efficient central station, industrial and process components, Foster Wheeler has installed in this new plant, near Wilkes-Barre, Pa., the latest, most modern equipment, such as: the 8000-ton beam press, 2 million volt x-ray facilities, the newest developments in submerged arc-welding and high-speed drilling equipment, 83½ foot long stress-relieving furnace and others shown here.

This modern equipment, plus the plant's proximity to steel supplies, and its strategic location for direct rail shipment to all areas of the country, assure you of fast, economical, high-quality fabrication to meet your specifications for the largest and heaviest drums and pressure vessels.

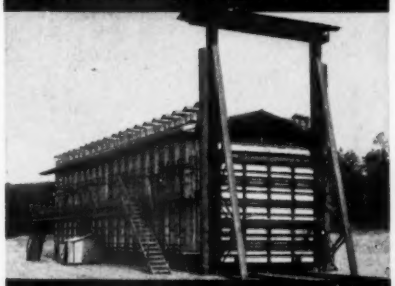


2,000,000 volt x-ray facilities enable operators to see through 12 inches of steel.

10. **DRUM FACING MACHINE**
Quick preparation of ends of cylinder for assembly with heads.



Artist's sketch of the main bay of the new Mountain Top, Pa. plant. 800' long, 90' wide, 75' high.



Stress relieving furnace permits annealing of fabricated parts more than 83 ft. long.

Shot blast building is equipped for surface cleaning by latest practice.

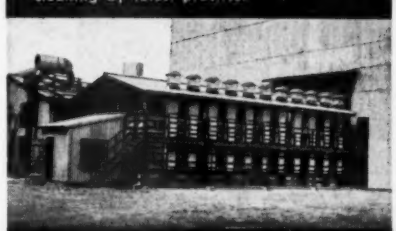


Plate normalizing furnace will take the largest available plates for preheating prior to bending or rolling.

FOSTER WHEELER CORPORATION

Designers and Constructors of

Stationary and Marine Steam Generators and Condensers
Process Equipment • Chemical and Petroleum Plants

NEW YORK • LONDON • PARIS • ST. CATHERINES, ONTARIO

FOSTER WHEELER

Unloaded 3,207,708 Tons

ENGINEERING DATA

MODELS: 5-ton HD (Heavy Duty) . . . 3½-ton GS (General Service) . . . Both fit all hopper bottom cars in domestic service.

DUTY: GS Model generally recommended for 10 cars per day, HD Model up to 100 cars per day handling wet, compacted or partially frozen loads. (Capacity figures vary depending upon characteristics of material).

SPECIFICATIONS: 5/32" stroke—1,500 vibrations per minute (easily adjustable for specific applications) . . . Motor platform suspended on coil springs to protect motor from vibration . . . HD Model vibrating frame of welded construction throughout, stress relieved after welding . . . GS Model fabricated from rolled sections of riveted construction . . . Both Models available with recommended companion twin-hook Car Shakeout Hoist.

Patent No. 2,504,789

HEWITT-ROBINS INCORPORATED HR

HEWITT-ROBINS

EXECUTIVE OFFICES, STAMFORD, CONNECTICUT

and Never Missed a Day!

Customer's Performance Record

EQUIPMENT: Hewitt-Robins Heavy Duty Car Shakeout.

LOCATION: Bradford Dock of the Carbon Fuel Company, Kanawaha River, Marmet, W. Va.

OPERATION: Unloading coal from hopper cars.

PERFORMANCE: This Hewitt-Robins Heavy Duty Car Shakeout unloaded approximately 50 cars a day, every day for 6½ years without missing a complete day . . . unloaded a total tonnage of 3,207,708 tons . . . average unloading time of 2½ minutes per car under normal conditions (even partially frozen coal unloaded in 10 minutes). During this period of operation, the Car Shakeout has never been torn down and the original shaft, bearings and vibrator assembly are still intact . . . only maintenance required was replacement of V-belts and springs.

RESULTS: The Carbon Fuel Company reports that this unit has paid for itself *many times over in man-hours saving alone.* Now only four men are needed to handle car unloading operations at the dock . . . whereas, six to eight men were normally required before the Hewitt-Robins Heavy Duty Car Shakeout was installed.

CHECK FOR INFORMATION ABOUT THESE JOB-TESTED PRODUCTS FOR YOUR OPERATION

CONVEYORS:
- ☐ —Belt
- ☐ —Dock
- ☐ —Sectional
- ☐ —Vibrating

BELTING:
- *☐ —Elevator
- *☐ —General
- *☐ —Rayon
- ☐ —Woven Wire
- ☐ BUCKET ELEVATORS
- ☐ IDLERS

SCREEN CLOTH:
- ☐ —Electrically Heated
- ☐ —General
- ☐ VIBRATING SCREENS

HOSE:
- *☐ —Air
- *☐ —Fire
- *☐ —Flexible Rubber Pipe
- *☐ —Pinch Valve
- *☐ —Servall®
- *☐ —Steam
- *☐ —Twin-Weld®
- *☐ —Water
- ☐ MECHANICAL FEEDERS
- ☐ STACKERS
- ☐ CAR SHAKEOUTS

TRIPPERS:
- ☐ —General
- ☐ —Dust Seal
- ☐ BELT CLEANERS
- ☐ CRUSHERS
- ☐ STOCKING & RECLAIMING SYSTEMS
- ☐ DESIGN AND CONSTRUCTION OF COMPLETE MATERIALS HANDLING SYSTEMS

*For immediate information about these industrial rubber products, call your Hewitt Rubber Distributor (See "Rubber Products" Classified Phone Book).

Hewitt-Robins Incorporated
666 Glenbrook Road
Stamford, Connecticut

NAME

TITLE & COMPANY

STREET ADDRESS

CITY PO ZONE STATE

290A

INCORPORATED

DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam
FOREIGN SUBSIDIARIES: Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • EXPORT DEPARTMENT: New York City.

YOU CAN'T PREVENT SLUDGE...BUT YOU CAN

CONDITION SLUDGE

...with Dearborn Formula 659

● Sludge—the ever-present thief of boiler efficiency—can be controlled with Dearborn's sludge-conditioning Formula 659.

IMPORTANT FUNCTIONS OF FORMULA 659

PREVENTS sludge from adhering to boiler surface.

PROVIDES colloidal action; prevents crystalline scale formation.

PRODUCES better quality steam by modifying bubble formation responsible for foaming conditions.

ELIMINATES corrosion in feed lines, heaters and internal boiler surfaces caused by dissolved oxygen.

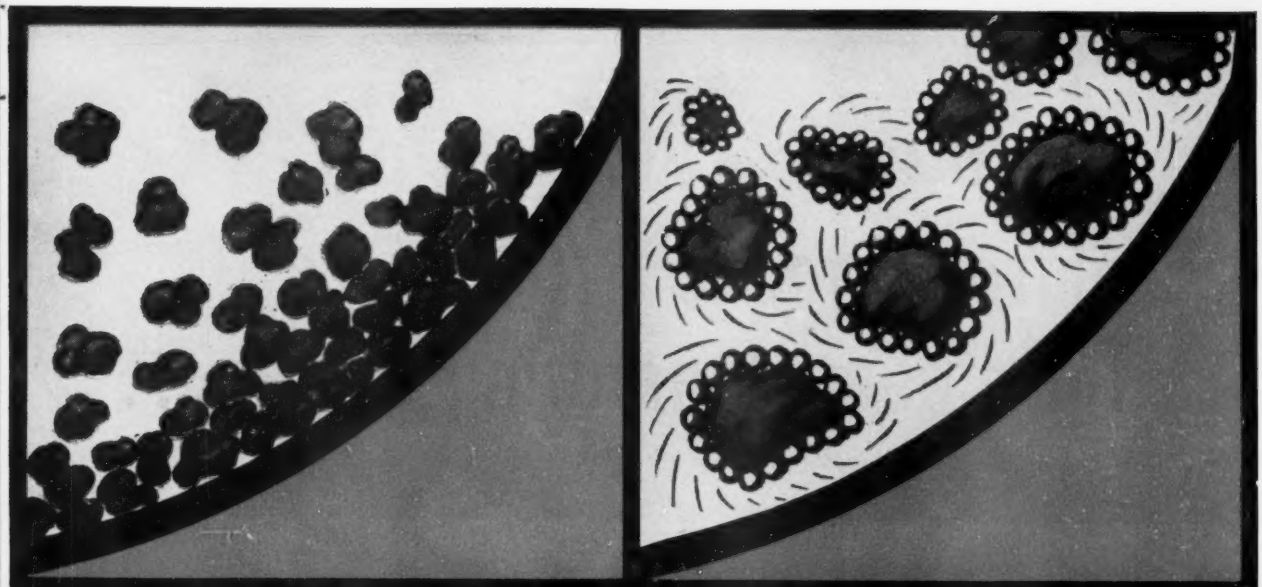
Compatible with other treatments, this Dearborn formula will greatly reduce maintenance and production costs.

Dearborn

TRADE MARK

COMBATTING CORROSION EVERYWHERE SINCE 1887

DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois



THIS IS UNCONDITIONED SLUDGE
Untreated sludge particles settle into a compact mass, preventing water contact with metal surfaces and producing sludge-type scale.

THIS IS CONDITIONED SLUDGE
Treated sludge particles, surrounded by water molecules, produce fluid and non-adherent particles which prevent packing and attachment.

DEARBORN FORMULA 134 REMOVES SCALE

Many waters tend to form scale in pipes and cooling jackets, impairing valuable equipment, adding unnecessary labor and shutdown time. Formula 134, a concentrated solvent, removes scale in heat exchange units, boilers, pumps, feed lines, meters and condensers! Bulletin 5002 describes removal of scale with Dearborn Formula 134.

DEARBORN Filmeen Stops Return Line Corrosion

If corrosion makes frequent replacement of return lines, fittings and other equipment necessary, your plant engineer will want to know more about corrosion control with Dearborn Filmeen . . . Bulletin 5013 gives the complete story.

your Dearborn Engineer

will visit your plant, analyze the pertinent waters, make recommendations for the proper treatment and the equipment necessary to establish a simple control that eliminates unnecessary expense.

WRITE FOR THESE VALUABLE BULLETINS

Dearborn Chemical Company
Merchandise Mart Plaza
Chicago 54, Illinois

Dept. PO

Please send me

- ☐ Bulletin 5008-A—Dearborn Formula 659
- ☐ Bulletin 5000 —Dearborn Industrial Water Treatment and Engineering Service
- ☐ Bulletin 5013 —Dearborn Filmeen
- ☐ Bulletin 5002 —Dearborn Formula 134
- ☐ Have a Dearborn Engineer call

Name.....

Position.....

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City.....*State*.....

an outstanding trio of refractories for steam-generating plants...

HARBISON-WALKER

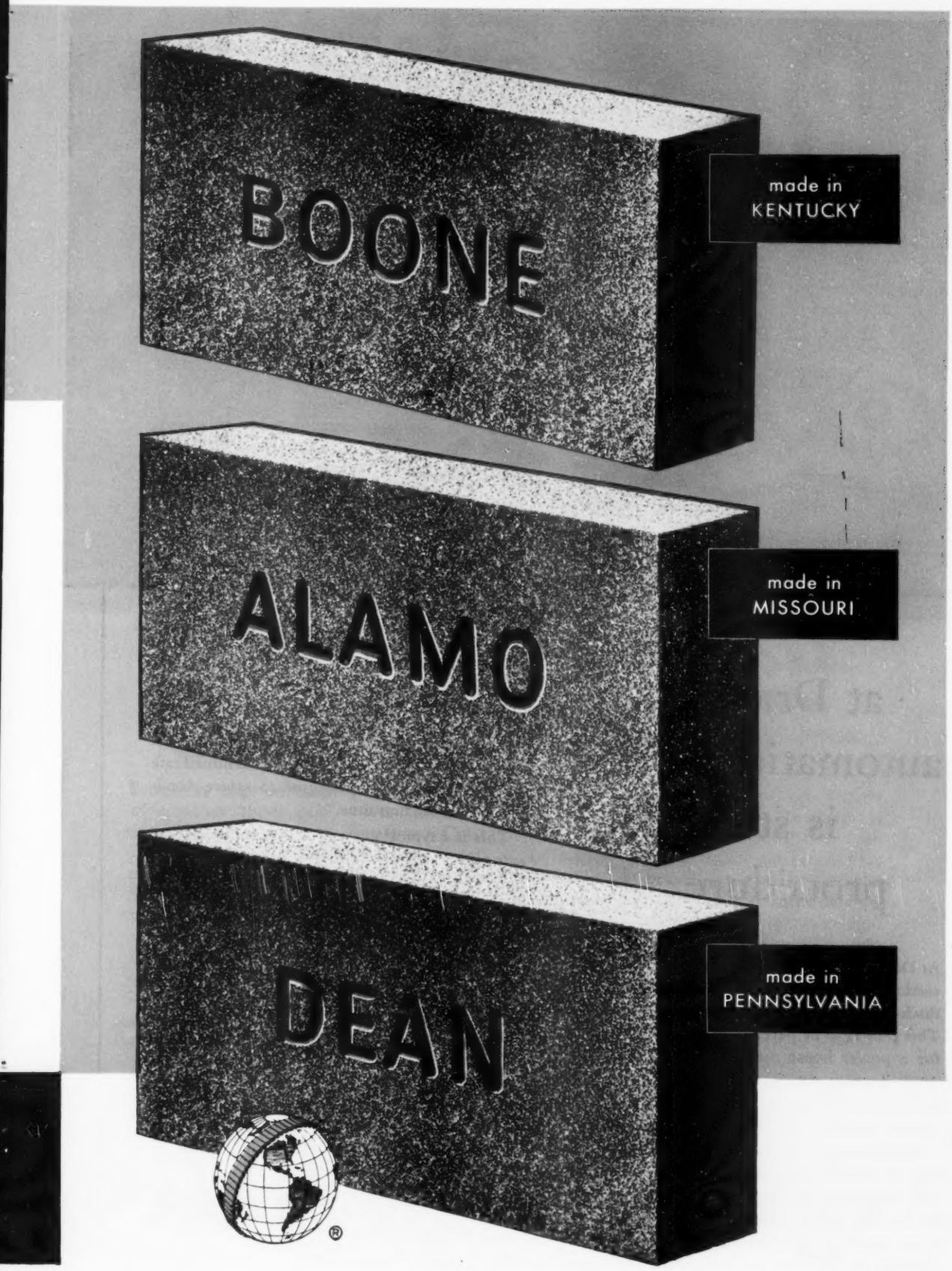
super-duty FIRECLAY BRICK

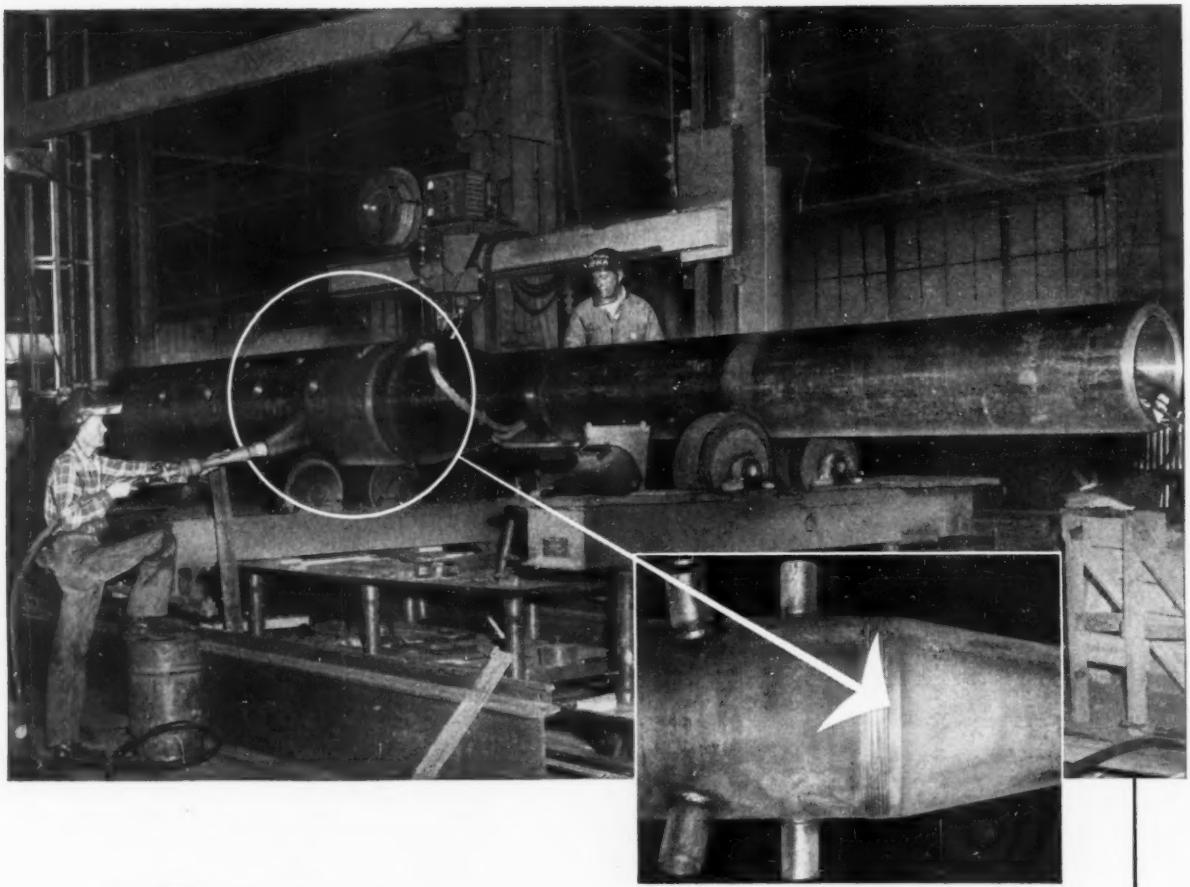
The highest attainment in their physical properties, such as refractoriness, spalling resistance, density and degree of impermeability to slags provides the extra margin of quality required for maximum service.

Harbison-Walker manufactures Super-Duty Fireclay Brick from flint clays of the highest quality at widely separated plants—DEAN brand in Pennsylvania—BOONE in Kentucky and ALAMO in Missouri. These brands are most economically available where needed.

In addition, VARNON and KENMORE brands of the extra hard fired Super-Duty class are included in the Harbison-Walker complete line of refractories.

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
World's Largest Producer of Refractories
General Offices: Pittsburgh 22, Pa.


BOONE
made in
KENTUCKY
ALAMO
made in
MISSOURI
DEAN
made in
PENNSYLVANIA



at Dravo, automatic welding is standard procedure

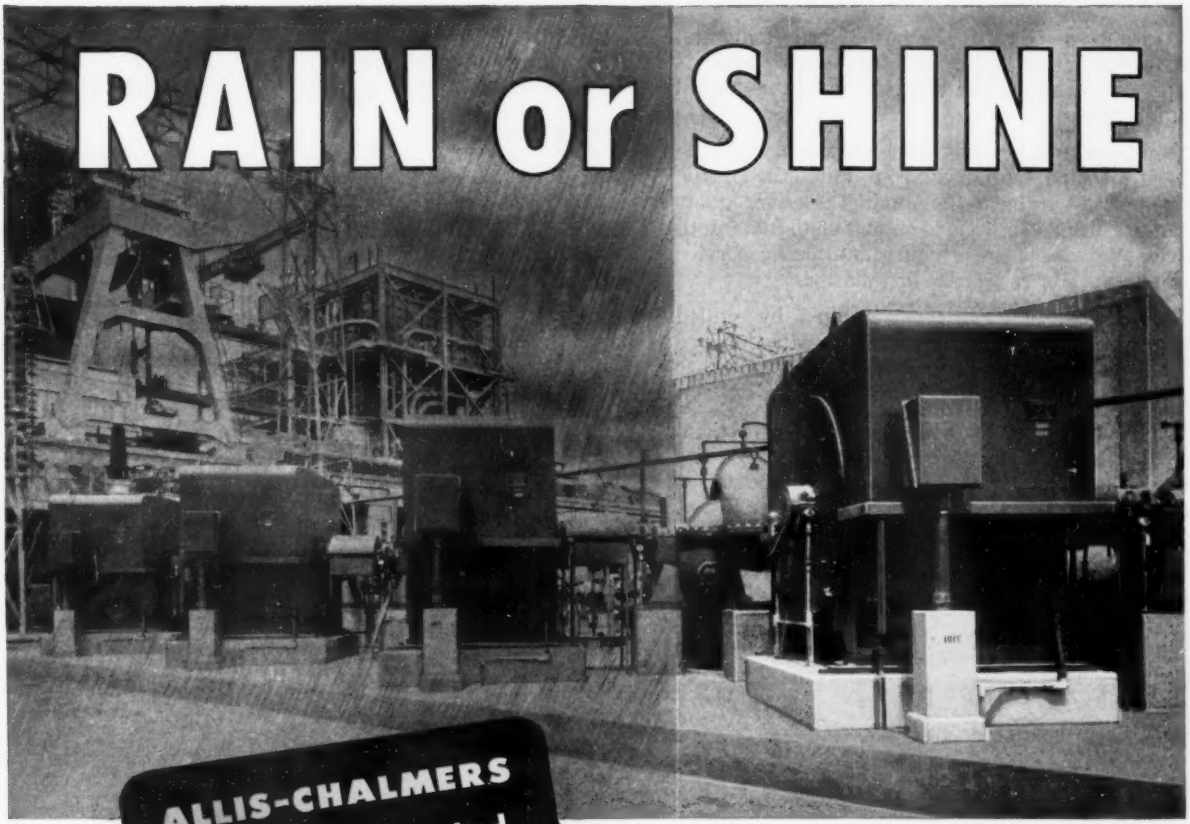
At Dravo's Marietta Pipe Fabricating Plant two sections of alloy-steel pipe with 3¼-inch wall thickness are being joined by automatic welding. This pipe is to be part of the main steam piping for a power house operating at 1550 psi and 1000 F steam conditions. For this service, the weld must be "sound" as the pipe itself—and the job must be "right the first time."

For this particular fabrication the two adjoining ends of the pipe were maintained at 500 F, with thermocouples recording the temperature, during the entire automatic welding operation. After welding, the fabricated pipe was immediately placed in a stress-relieving furnace, brought at a controlled rate to a temperature of 1300 F for one hour per inch of wall thickness. The pipe was then cooled at a predetermined rate and radiographically inspected to assure that it was "right the first time."

This is a typical example of the application of automatic welding at Dravo. Procedures have been developed in compliance with pressure piping codes so that automatic welding of all grades of carbon steel and many grades of alloy steel at Dravo is standard practice. This is one of the many reasons why Dravo is called upon constantly for all types of fabricated piping.

Let Dravo serve you. Write for complete information and ask for Bulletin No. 4-1700.

DRAVO
CORPORATION
Piping Department
Fifth and Liberty Avenues, Pittsburgh 22, Pennsylvania



ALLIS-CHALMERS
Weather-Protected MOTORS

Low-cost outdoor installation plus dependable operation under all weather conditions

Economy plus reliability — regardless of weather conditions — was the combination demanded by Southern California Edison for the circulating water pump motors at the 250,000-kw Etiwanda Steam Station. And that's the combination delivered by the four Allis-Chalmers motors shown above.

Each of these modern weather-protected squirrel-cage motors is rated 900 hp, 4160 volts, 435 rpm. Smaller motors of similar design were supplied by A-C for the station's condensate booster pumps.

Proved by Special Tests

The weather-protected design has been tested under extreme conditions. Running at normal speed and voltage, motors of this type were deluged with water at rates up to 40 inches per hour — driven by winds up to 75 miles per hour. This was done repeatedly from all angles, but on inspection no moisture was detected on the windings. And other tests checked effectiveness in keeping out wind-driven fine sand — a serious threat at this west coast installation.

Movie and Bulletin Available

See how A-C test-proved these motors. Ask your A-C representative to show you the 12-minute movie *The Sky is the Roof*. Or write for Bulletin 05B7874. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4176

ALLIS-CHALMERS

PROGRESS today in the power, processing and construction industries frequently depends upon new and varied types of heavy metal equipment.

Designing and building this equipment has long been an Alco specialty. From Tulsa to Trieste, from Pittsburgh to Palembang, Alco products ranging from 4-in. welded steel pipe to mammoth pressure vessels are giving outstanding service in all types of industrial installations.

This wealth of experience—applied by skilled engineers and craftsmen working with modern facilities—enables Alco to design and fabricate heavy equipment to meet rigid specifications.

Select your toughest heavy-equipment problem —then send it to your nearest Alco Products Sales Engineer. He'll quickly show you how Alco can produce the answer you've been looking for.

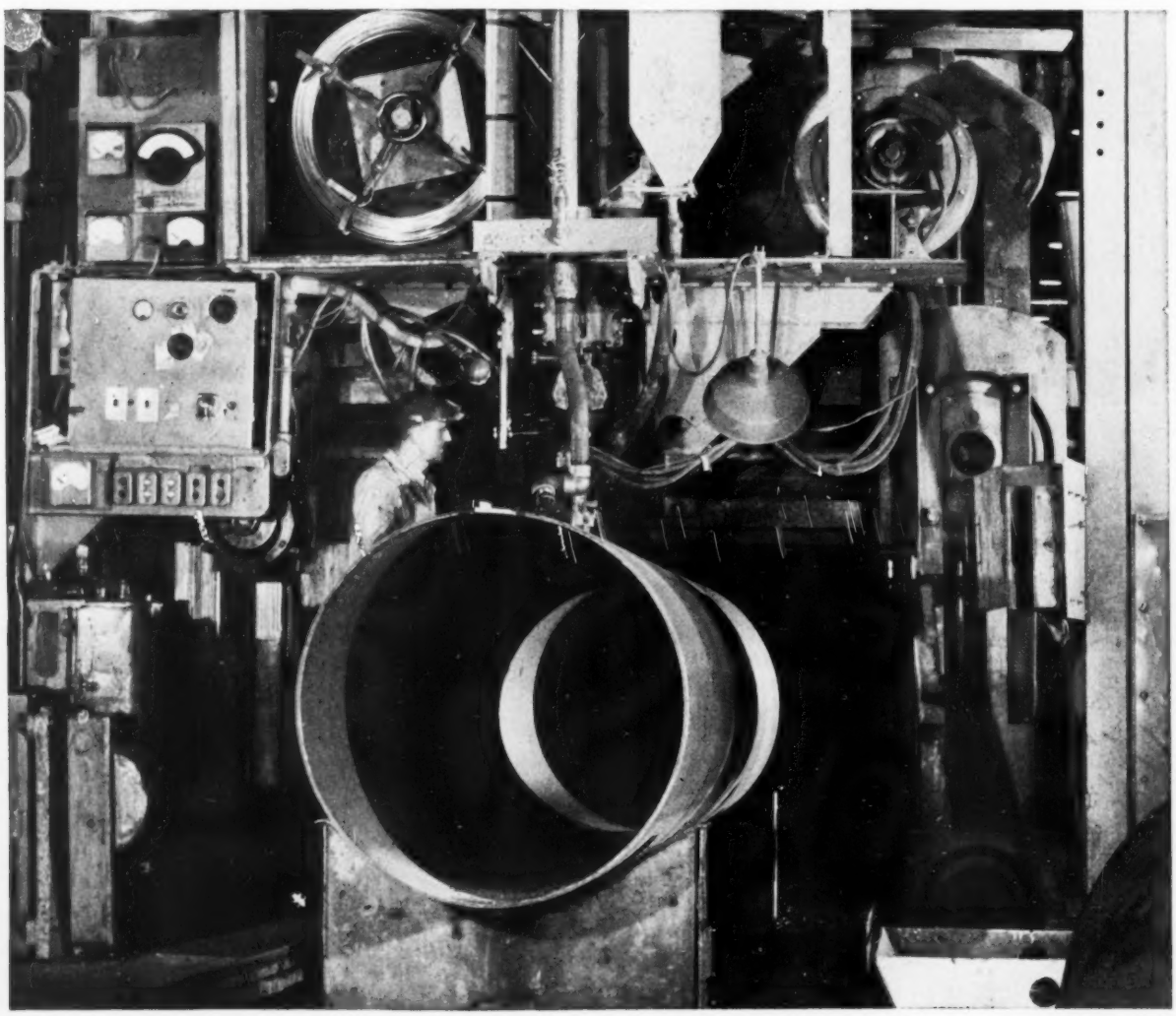
Alco Products Sales Offices are located in New York, Chicago, Dunkirk, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

Alco speeds progress in

Answers to

Alco

ALCO'S MODERN PRODUCTION FACILITIES, designed to handle economically many difficult metal-fabricating operations, include this automatic submerged-arc welding machine. Welds made on this machine must pass the most rigorous leak tests ever devised for commercial welding.



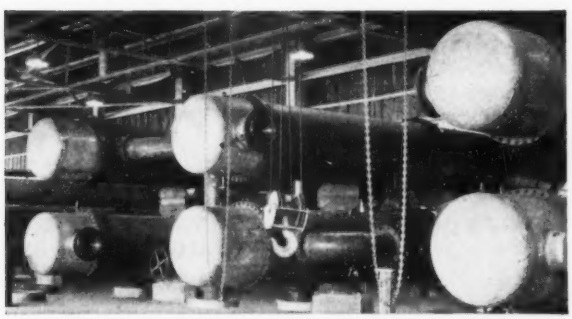
power and petroleum, chemicals and construction, with...

New Industrial Problems

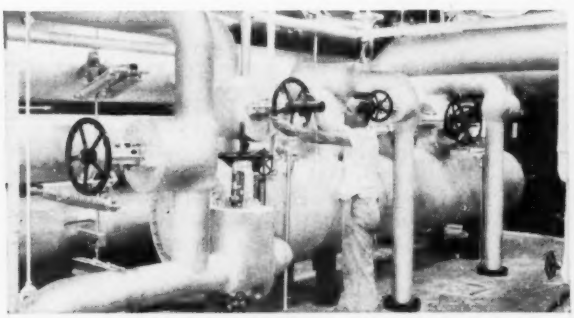
ALCO

ALCO PRODUCTS DIVISION

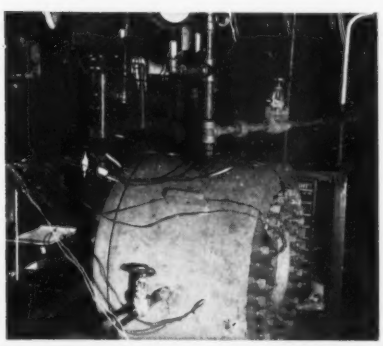
AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK



CUSTOM-BUILT HEAT EXCHANGERS ready for final piping in Canadian Chemical Company, Ltd.'s $55 million plant now under construction near Edmonton, Alberta. These units are among the more than 200 special reboilers and heat exchangers being supplied to the new Canadian plant by the Montreal Locomotive Works, Ltd., an Alco affiliate.

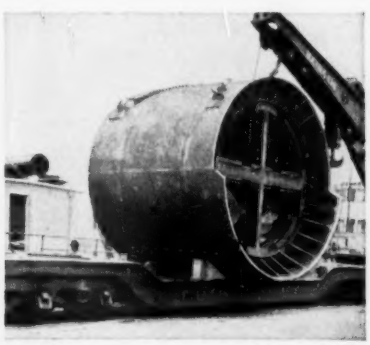


ALCO FLEX-TUBE EVAPORATORS incorporating many new features help boost efficiency at Carolina Power and Light Company's new 150,000 kw plant at Goldsboro, N. C. These specially designed Alco units produce vapor containing one part per million or less of mineral solids. Make-up to the system has been found to be less than one-half of one per cent.



NEW HIGH-PRESSURE CLOSURE, shown here during high-temperature tests, is typical of the many heavy-equipment improvements developed by Alco engineers for service throughout industry. (Reprints of article, "Engineering Development of Alco's New High-Pressure Closure," available upon request.)

ALCO WELDED STEEL PIPE was furnished for the chilled water lines in the U. S. Government's new $4\frac{1}{2}$ million walk-through tunnel, part of a Capitol Power Plant improvement project, now under construction at Washington, D. C. The 30-in. main lines (on tunnel floor) total about 9,280 ft., branch lines about 1,200 ft.



GIANT TUNNEL SHIELDS illustrate the variety of special heavy-metal equipment designed and fabricated by Alco for power, petroleum, chemical and construction companies the world over. Other items built by Alco to meet strict specifications range from tar stills to stripping towers, cement kilns to jet-engine containers.

"Buffalo" *Tips on Better Pumping*

5 WAYS to Get the Most From Your PUMPING INVESTMENT

1. MATCH THE PUMP TO THE CONDITIONS

First, determine all possible conditions of the liquid to be pumped—chemical analysis, suction lift (if any), head or pressure, specific gravity and temperature of liquid—then pick the exact pump made for those conditions. (In the "Buffalo" line, you'll *find* that "ideal" pump, because the line is so complete.)

2. SAVE ON FIRST COST BY USING HIGHEST RECOMMENDED DRIVER SPEED

The higher the speed, the more the pump will deliver—within reason—and the smaller the pump you can use for a given job. But be sure to operate at no higher than recommended speeds. Overspeeding wears out any pump.

3. RIGHT INSTALLATION AIDS PERFORMANCE

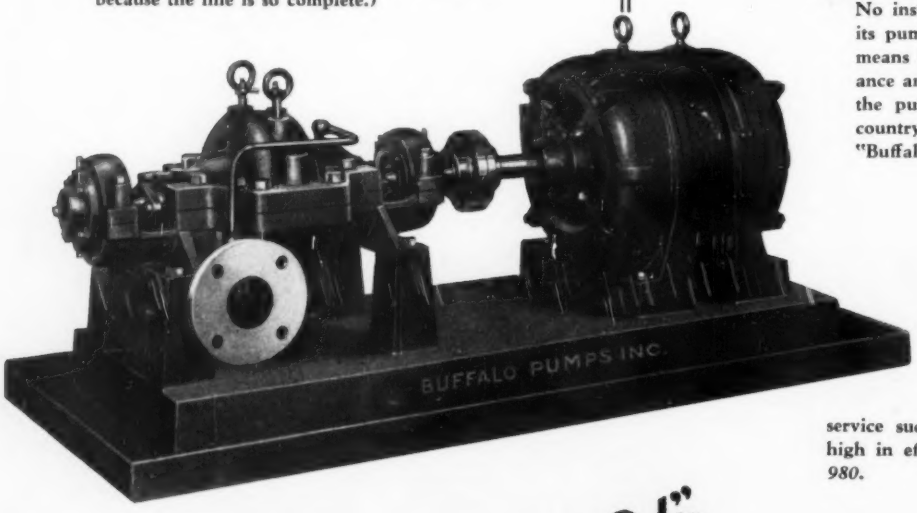
Give your pump the best chance—install close as possible to liquid supply source—keep pipe friction losses to a minimum—be sure suction line has no humps or hollows which could cause air locks. (You'll find "Buffalo" Pumps compactly built and easy to install.)

4. REGULAR MAINTENANCE SCHEDULE LENGTHENS PUMP LIFE

Regular inspections and servicing of bearing lubrication, shaft alignment, packing, impeller not only keep your pumps running smoothly, but head off minor conditions which could develop into problems later on. (You have a long-life "bonus" to start with if your pumps are "Buffalo"!)

5. A QUALITY PUMP IS ALWAYS AN ECONOMY —SPECIFY "BUFFALO"

No installation can be better than its pump. For known quality that means long life, efficient performance and simple maintenance, pick the pumps used in many of the country's largest installations—"Buffalo" Pumps.



"BUFFALO" TYPE RR PUMP FOR HIGH PRESSURES—

—multistage design for clear water service such as boiler feed. Rugged, high in efficiency. *Write for Bulletin 980.*

BUFFALO "Buffalo" PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

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A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Afterthoughts on Atomic Power

EVENTS ARE MOVING FAST on the atomic front. A few weeks ago General Electric announced (see page 152) that it would ask the Atomic Energy Commission for permission to generate byproduct power from the plutonium production at the Hanford plant of AEC. Next, AEC announced its award of a contract (same page) to Westinghouse to build a 60,000-kw atomic power plant—to be finished in about five years at a cost of "many tens of millions of dollars."

A few days later, by pure coincidence, more than a thousand American industrialists—mostly nonengineers—patiently sat through two days of lectures on atomic power at a New York meeting of the National Industrial Conference Board.

What's the inner meaning of all this talk and action? Here, in brief, are my personal views.

First, it's safe to predict that several fair-sized atomic plants will be operating within six or seven years. I don't expect any of these will come within gunshot of competitive costs per kilowatthour—except by crediting power costs with plutonium sold to the Government at cold-war prices, for uses that are essentially military. By *military* I mean for bombs, artillery shells, warship propulsion and such uses.

If there were no cold war, and if nobody were worrying about A bombs and H bombs, I don't think atomic power would seem so urgent. Chances are we would be calmly discussing uranium as the "fuel of the future," to be developed gradually when our reserves of conventional fuels begin to run dry.

It must be granted that even the earlier atom-bomb plants may show a fuel-cost saving over coal, oil and gas. And "breeder" operation of the reactors will eventually make uranium fuel equivalent to coal at a few cents per ton. Yet I feel that the much higher first cost of the atomic power plants, and the complexities of fuel processing, will offset the lower fuel costs for many years. Again, this leaves out the plutonium subsidy, which may prove to be undependable in the long run.

If atomic plants are generating most of America's power a few decades from now, we shall be saving much of the money that would otherwise be spent for power-plant coal, oil and gas. This will be tremendously important for power and fuel men, but certainly not revolutionary from the national standpoint, since the total cost of all coal, oil and gas burned in central power plants is less than a half of one percent of the national income.

Despite soothing talk about "finding peaceful instead of military uses for the atom" I am convinced that the main moving force behind atomic power is military need. This becomes clear as we review some of the terribly important military and strategic facts: that Russia has the A bomb and probably the H bomb—that America must be top dog in atomic war potential so the fear of retaliation will hold off any enemy attack—that every atomic power plant will be a producer of byproduct plutonium—that the design, building and operation of atomic power plants will train many engineers in atomic techniques—that a "forced-draft" atomic-power program may lead to unpredictable atomic discoveries, and that these may become a matter of life and death to this nation—that a going atomic-power industry will help America keep foreign suppliers of uranium on our side.

To sum up, it is certain that atomic power plants will be built. I feel that they *should* be built—mainly for reasons of national security. To a large extent they will be built, equipped and operated by men who read POWER. That is the reason for this blunt summary of my personal views regarding the future of atomic power.—PHIL SWAIN

HERE'S A STORY EVERY PLANT OPERATING MAN SHOULD READ

"Heating in our main switch was causing Shutdowns But we stopped them cold by changing to Fusetron dual Element Fuses"

"In the Fall of 1951 in our cafeteria, we installed a new 1200 ampere switch. This switch controlled the lighting, refrigeration and a 115 ton air conditioning load.

"Everything was fine until the temperature reached 85 degrees and the summer air conditioning load came on. Then we had trouble.

"Three times in May, 1952 during our noon rush our whole place was shutdown.

"Our dining rooms seat 500 people at a time, so you can see what a shutdown during the noon rush means to us.

"We were fighting mad about the whole affair as the installation was practically new. Mr. Menees of the Arkansas Power and Light Co. was called in.

"He suggested that the trouble was due to the adding of the summer temperature to the normal heating of the fuses. Then he recommended that we discard our ordinary fuses and install FUSETRON dual-element fuses, as these modern fuses operated at a much cooler temperature than other fuses.

"This we did. To date, June 19, 1953, over one year since we made the change we have not had a shutdown due to a fuse blowing even though today's temperature outside is over 100 degrees.

"The cooler operation of FUSETRON fuses stopped shutdowns cold for us."

C. A. Franke, President
Franke's Inc., Little Rock, Ark.

FRANKE'S CAFETERIA in Little Rock, Arkansas, feeds several thousands of people daily. It is one of the oldest and best known eating places in the state and travelers have carried the fame of its fine food throughout the Nation.

Left: Mr. C. A. Franke, President, Franke's Inc.

Right: Mr. Bruce Menees, Industrial Engineer, Arkansas Power & Light Co.

You too, can profit by the 10 POINT PROTECTION of FUSETRON dual-element FUSES

1 *Protect against short-circuits.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.

4 Provide thermal protection—for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York.

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

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TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
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FOR MORE INFORMATION *use this Coupon*

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The LONGER LIFE of WROUGHT IRON PIPE

proves...

It costs less to do it right

—than to do it over!

When you specify pipe there are two things well worth remembering—

1. When you install it, you pay only the pipe fitter,

but

2. Every time you repair it, you pay pipe fitter, carpenter, mason, plasterer, and painter.

This dollars-and-cents difference underscores the fallacy that low-first-cost materials are the answer to piping economy. And these same facts provide a yardstick that places the economy emphasis where it rightly belongs . . . on PIPE SERVICE LIFE. The longer service life of wrought iron pipe has proved to thousands of users that it costs less to do it right than to do it over. In installation after installation, wrought iron pipe has doubled, tripled, and even quadrupled the useful life previously obtained from low-first-cost piping. These users have discovered that although you pay a little more for wrought iron, you pay a LOT LESS FOR MAINTENANCE. Wrought iron gives you piping economy because it lasts longer, at lower cost per year.

We'll welcome the opportunity to discuss your particular corrosion problems, and to show you wrought iron durability records in services similar to those in which you are interested. Write or call. Your request will be handled promptly.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N. Y.

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glasslike silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

a **Power** *handbook*

FUEL Handling and Storage

by J C McCabe, Associate Editor

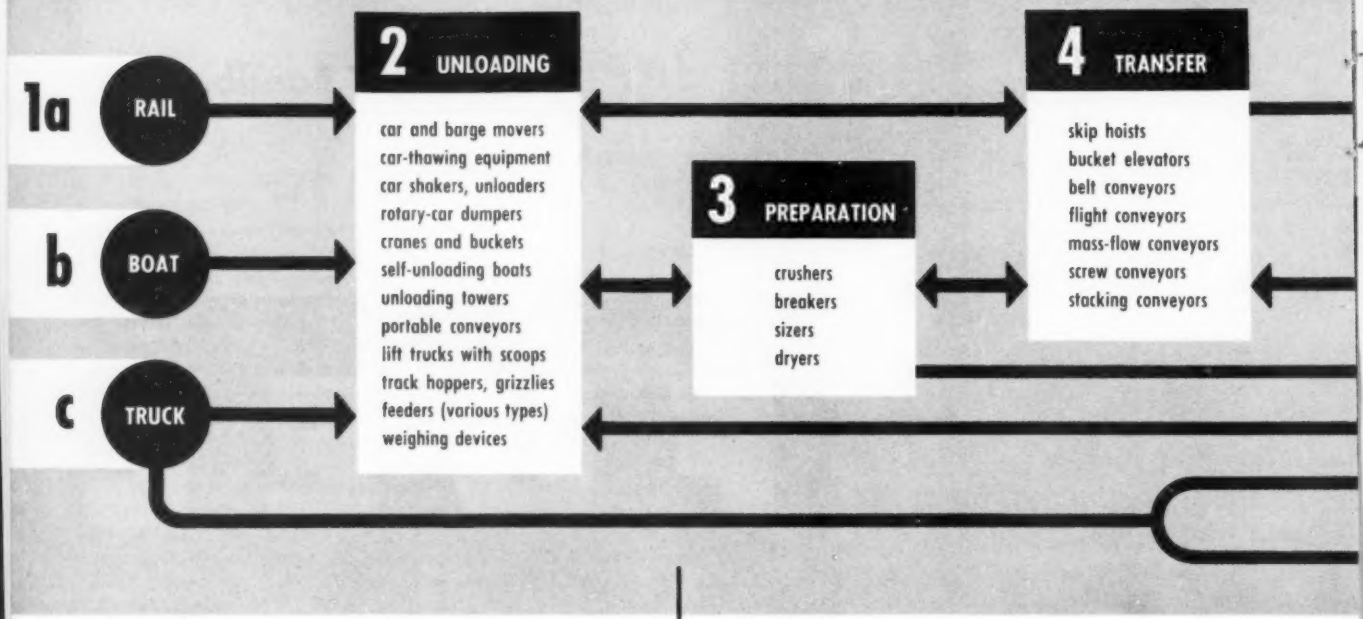
We've come a long way since fuel handling meant a man with a strong back, a big shovel and a rusty wheelbarrow. Faced with steadily rising costs, we have learned the value of mechanizing to eliminate labor, to use men's brains instead of their brawn.

As a result, we now have an imposing array of devices to move fuels faster, cheaper, more automatically. And we have the know-how to make handling and storing not only less expensive but also cleaner and safer. The trick is to apply the equipment and know-how — in your plant and all plants — to get the best over-all results for the given conditions.

To aid you in this dollar-saving job, we present this latest in a long line of POWER handbooks. In its pages you'll find a broad picture of the storage and handling function, a roundup of modern machines for the work, and the basic information you need to fit them into the combination that will solve your plant's particular problem — whether your fuel is coal, oil or gas.

In preparing this handbook, we've drawn freely on the literature of handling-equipment manufacturers and on the writings and suggestions of specialist engineers. We warmly acknowledge the helpful cooperation that everyone has given us.

December 1953



RECEIVING, UNLOADING

Unloading setup depends largely on the way coal arrives. Some forms of shipping — barges, for example — can't self-unload at all, so unloading equipment is an absolute necessity. Other types, like hopper cars, can self-unload, but we often install equipment to speed the job or make it easier under bad conditions (dumpers, thawers, shakers, etc). And frequently we add devices, such as feeders, to set up a controlled flow to the next step in the handling process.

PREPARATION, TRANSFER

If coal is bought unsized, and sizing is desirable for storage or firing, *preparation* may be done near the receiving point, as diagrammed, or in plant near point of use.

By *transfer*, we refer to handling between the unloading point and the final storage point from which coal normally discharges to the firing equipment. It may involve only one piece of equipment, or several, depending on local conditions and whether there is more than one storage.

COAL HANDLING: For its few or many steps . . .

In essence, the job of a handling system is to move coal from a receiving point to the firing equipment. Whether it's simple or complex depends on how we receive the coal, how the plant is situated, and what we expect from the system in capacity, flexibility, convenience, etc. To meet such a variety of conditions and requirements, we have an extensive array of mechanized handling devices, which may be combined in almost innumerable ways.

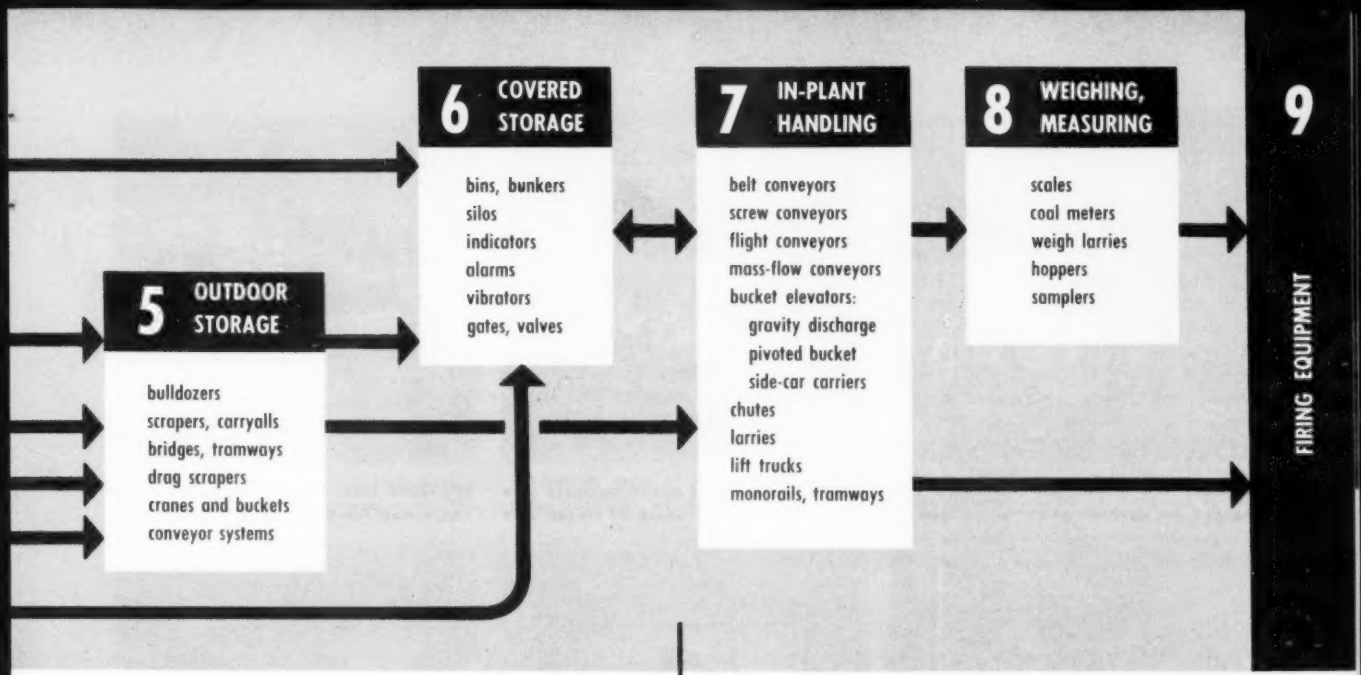
Basic Steps. It just isn't possible to set down what we might call a *typical* coal-handling system. What we've tried to do in the chart above is break down the over-all operation into typical steps, explain the general function of each, and give some idea of the many ways they can be combined. And for each step, we've listed typical devices used.

How Chart Works. Before taking a look at some of the combinations diagrammed, let's be sure we know how it works. To make the over-all picture clearer, the chart divides it into steps or functions. Not all of these need be involved in any actual case. Nor will they always stand out clearly as separate operations — a single piece of equipment may, in practice, handle two or more of these functions.

The order in which steps are charted is close to that likely to be followed in many cases. But specific operations, such as preparation or weighing, may be handled at other points than those shown. Finally, while flow arrows indicate a great number of combinations, the chart cannot, in the nature of things, cover all of the many possible arrangements.

Within these limitations, however, the chart helps to show what's involved in this coal-handling job and thus serves as a useful introduction to discussions of functions and equipment that follow.

Simple Setups. Now let's look at some possible setups, see how conditions influence them, and how the chart pictures them. Simplest situation might be a basement plant in a city building, with coal received



STORAGE

Since it isn't practical to deliver coal at the rate it's burned, we use storage to permit less frequent shipments and to iron out variations in delivery. Storage may be outdoors or under cover — either in a silo or similar outside structure, or in bins or bunkers in the plant. It's now common practice to have a relatively small storage for normal needs and a larger one (often outdoors) for reserve, with means for transferring from dead to live storage.

IN-PLANT HANDLING

In plant here refers to handling between final storage and the firing equipment. Sometimes this would mean no more than chutes to direct flow to individual firing units and gates or valves to control flow. Or, we might have a conveying system to feed coal from any bunker section to any firing unit and to move coal from one bunker section to another. Weighing or measuring may be done near firing units, at the receiving point, or at both locations.

. . . a growing array of equipment combinations

by truck. Truck dumps directly to a bin, from which a screw conveyor carries coal to a stoker. On the chart this would be 1c-6-7-9.

In another relatively simple setup, railroad cars discharge over a track hopper and a bucket elevator lifts coal to the plant bunker. From here it flows through chutes to stoker hoppers (1a-2-4-6-7-9).

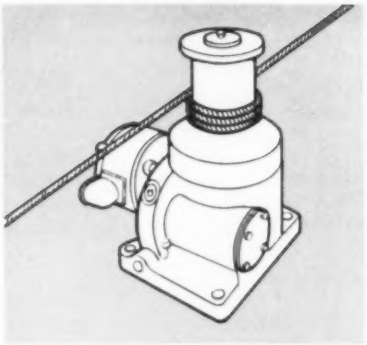
Adding Elements. Now let's suppose the plant gets some more boilers and extends the bunker. To distribute along the length of the bunker we add a horizontal conveyor over it. This means more transfer equipment, although chart sequence is still 1a-2-4-6-7-9. But to improve operation we add coal scales. Then we have another chart step, and sequence is 1a-2-4-6-7-8-9.

To protect against major delays in shipments, we add an outdoor storage and a bulldozer for building the pile. To provide an initial pile for the dozer to work from we use a portable conveyor. The dozer reclaims to the track hopper. Then, when we're using the outdoor pile, the coal-handling sequence becomes 1a-2-5-4-6-7-8-9.

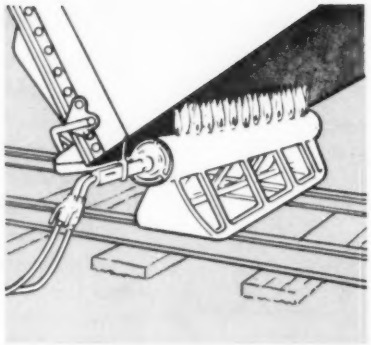
Complex System. Now, to give the chart a real workout, let's look at an actual system receiving coal by both water and rail. A coal tower unloads the barges and a conveyor carries coal to a crusher house (1b-2-4-3). A rotary car dumper unloads rail shipments to a hopper feeding another conveyor leading to the crusher house (1a-2-4-3).

The crusher house serves as a transfer point for routing coal into the plant or to a drag scraper for building an outdoor pile and reclaiming from it. So for direct handling into the plant the over-all lineup is: 1a-2-4-3-4-6-7-8-9 or 1b-2-4-3-4-6-7-8-9. When we're stockpiling and reclaiming, the procedure is 1a-2-4-3-4-5-4-6-7-8-9 and its equivalent for water shipments.

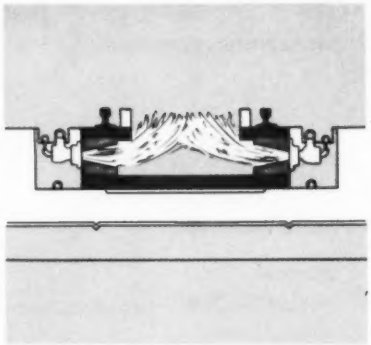
Many Combinations. While these examples are but a few of many possible arrangements, they're enough to show that each system consists of certain basic functions combined to meet specific job requirements and conditions.



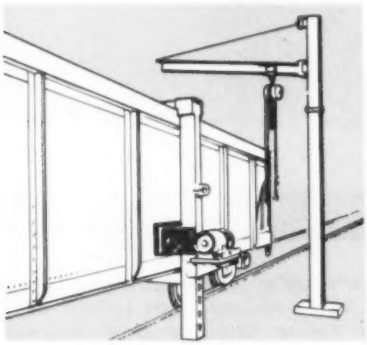
PULLERS and positioners spot cars and barges at desired point for unloading



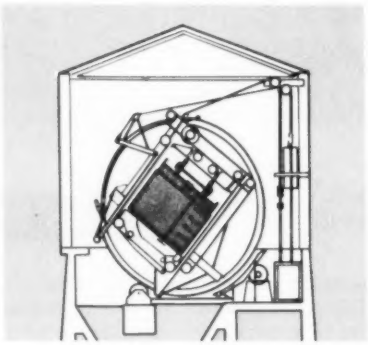
PORTABLE THAWERS prove valuable aids in speeding up unloading of frozen cars



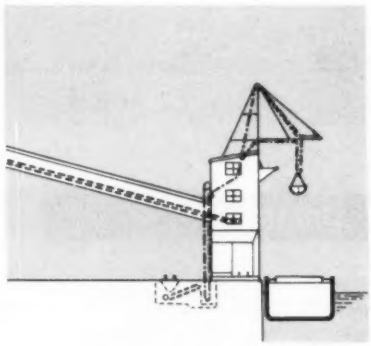
THAWING PITS, built between the rails, serve well for handling large shipments



LIGHTWEIGHT SHAKER, swung from hoist or wheel-mounted, is handled by one man



ROTARY CAR DUMPER gives fast high-capacity unloading, can do weighing also



COAL TOWER with clamshell bucket lifts coal from barges, delivers to conveyor

No matter how your coal arrives, there are . . .

First step in any handling operation, as we've just seen, is unloading incoming coal and doing it rapidly. Slow unloading not only means higher labor costs, it may mean demurrage charges as well. Thus, right at the start, it pays to mechanize as far as possible.

With labor costs looming so big, a host of mechanical aids to unloading have been developed. Which types are used in any given case depends, of course, on the way coal arrives, on the plant location, and the unloading capacity needed. A common rule of thumb suggests enough capacity to unload at least a 2-day supply in one 8-hr shift.

Equipment Used. Just what kind of equipment will do the best job for you depends first of all on how you receive coal. If it's delivered in a dump truck, and your setup is favorable, you may not need any equipment specifically intended for unloading. The truck dumps to a small outdoor storage or into a basement bin and that's it.

But even with self-unloading equipment you may need devices designed to make the job easier and to speed it up. For example, let's look at a plant that receives coal by rail, in hopper cars. In most cases, you'll need some means of bringing the cars to the right spot for quick, clean unloading. Often this will be a capstan (sketch above), also called a car puller or car spotter. With a cable connected to car and wrapped around capstan, motor pulls car to desired spot. In larger operations, motorized car haulers or industrial locomotives (diesel, fireless, steam) may be employed.

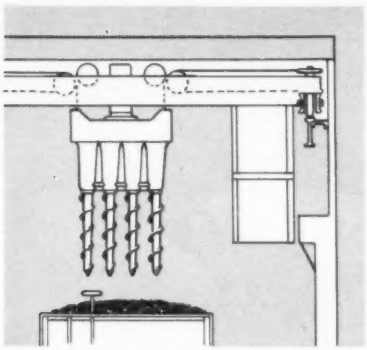
Frozen Cars. Where winters are cold, cars frequently arrive frozen. This can mean a nasty pick and crowbar job. But more and more plants are using thawing equipment—portable units like the one pictured above, or thawing pits built under the tracks and fitted with burners or, more rarely, steam lines. Some coal users pull cars into covered weather-protected sheds and then speed the unloading job with mechanical devices such as the accelerators, displacers or car shakers shown above.

These units really double in brass. Not only do they unload frozen coal—they greatly speed the handling of normal shipments. Coal, particularly when wet, has a tendency to compact in the car and hang up. Mechanical aids can speed unloading to less than 15 min per car.

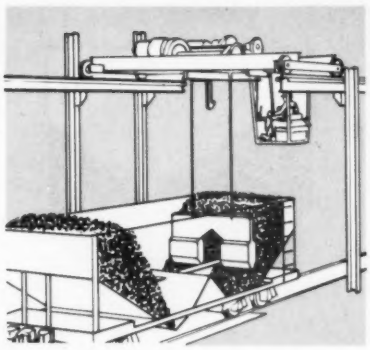
For fast, high-capacity unloading there is the rotary car dumper. This can handle gondolas and other cars that can't self-unload, and can be arranged to weigh coal also.

Track Hoppers. In all these cases, you've got to have some space to unload into. In some plants, coal cars run onto a trestle, with outdoor storage space beneath. A more common scheme is the track hopper, a pit (usually concrete-lined) under the tracks. As we'll see later, this forms the starting point for other handling steps. We'll also see some devices that permit unloading at ground level.

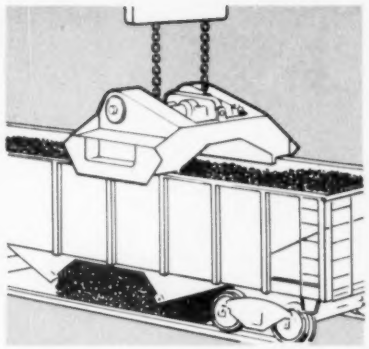
The general run of barges, boats and ships used for coal



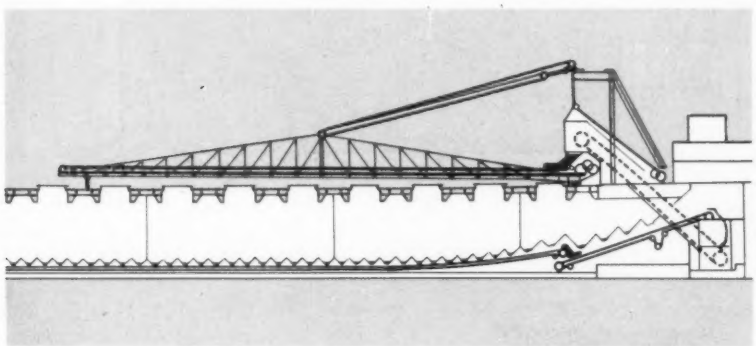
ACCELERATOR gets stubborn coal moving, overcomes wet coal's natural compacting



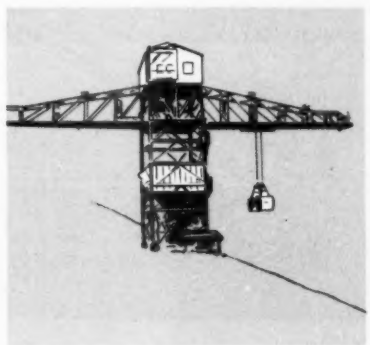
DISPLACER type of car unloader slices down through full width of packed coal



CAR SHAKERS speed unloading, cut time required per car to 15 minutes, or less



SELF-UNLOADING BOATS, found mostly in lake service, have long booms for lifting coal from holds, dumping it on shore. This may avoid need for dockside facilities



UNLOADING BRIDGE takes coal from barge, moves it into position for stockpiling

. . . devices to mechanize and speed unloading . . .

delivery cannot self-unload at all. Various types of fixed and locomotive cranes are used for hoisting from them.

Towers, Bridges. For large operations, specially designed towers and bridges are used. A typical tower is sketched above—a steel structure housing hoisting machinery, and a trolley boom for swinging bucket out over barge. In the inboard position, bucket dumps into hoppers feeding a conveyor. For details of a modern tower, see POWER, June 1951, pp 83-85. In addition to the fixed type discussed here, rail-mounted movable towers are used.

Coal bridges take many specialized forms but the essential feature is ability to deliver coal a short distance inshore, for further handling or stockpiling (see above).

Self-Unloading Boats. This specialized form of carrier, used mainly in lake service, carries its own unloading boom to deliver coal inshore for further handling or storage.

Most unloading methods, as we've seen, deliver fairly large slugs of coal at intervals. Track hoppers and other temporary storage piles absorb these variations in delivery rate but not all forms of conveying equipment can pick up directly from them. So we often add devices that can deliver coal at controlled rates to a point where a conveyor can pick it up conveniently for transport.

Portable Units. Two versatile forms of portable equipment can be used for this job, and for others as well. The familiar portable conveyor (sketch, next page) picks up coal at ground level and delivers it at a controlled rate to a higher point. The unloading conveyor, designed to fit under a railroad car, eliminates need for a hopper.

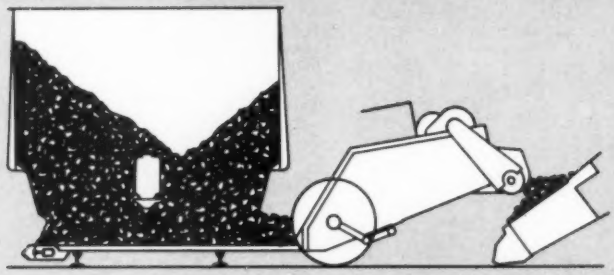
More often we turn to a family of devices called feeders (see illustrations, next page). These move coal short distances horizontally or at a slight upward angle but their main purpose is to control coal flow and prevent "flooding" of conveyors (or crushers often installed at unloading point). With coal coming at a uniform rate, conveyors operate at maximum efficiency. This reduces power cost and cuts down wear. Let's look at some feeder types.

Apron Feeders. Heavy and rugged in construction, these usually have twin chains mounting overlapping pans (18-in. wide and up). They differ from the familiar flight conveyor in that the pans carry the coal rather than drag or scrape it along, but they do have the usual head and foot assembly.

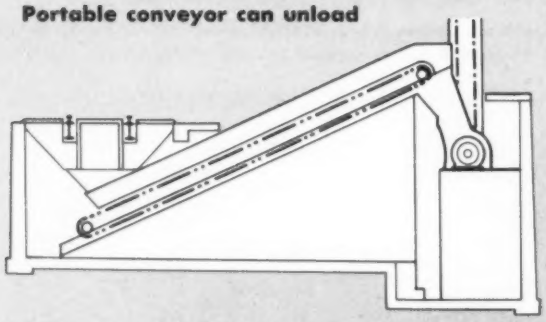
Apron feeders travel at low speeds, usually less than 25-30 fpm. They commonly have fixed side plates or skirt boards to protect the chains and to permit load to be carried at considerable depth before spilling over. As a rule, apron units don't run at angles greater than 25 deg, because at greater angles coal slides backward. If apron is fitted with cleats, it can run at steeper angles.

Using an apron feeder with an upward slope to control rate of flow from a track hopper has the advantage of reducing pit depth. In the case illustrated on p 81, an 18-in.

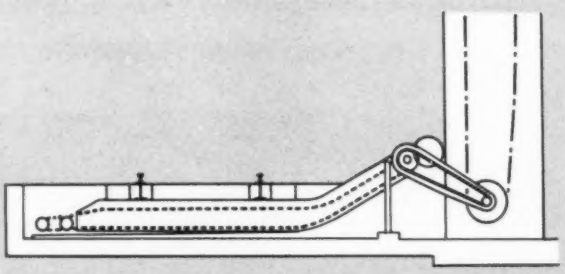
Portable conveyor can unload



Unloading conveyor acts at track level

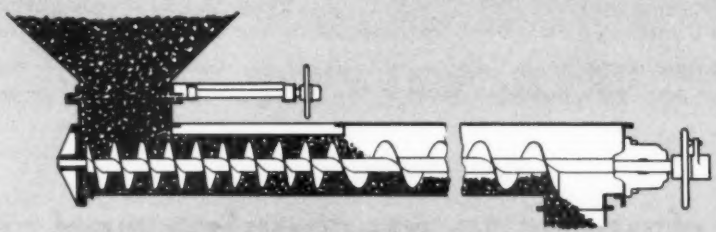


Angled apron unit reduces hopper depth



Bar-flight conveyor fits shallow track hopper

RAPID UNLOADING of coal carriers is essential on two main counts: (1) to lower handling costs, and (2) to avoid crippling pileups, with attendant demurrage charges. Equipment pictured here and on preceding spread does the job



Screw conveyor can be used as a feeder

. . . and a variety of feeders and conveyors . . .

unit running at 15 fpm can move up to 25 tph of stoker coal from a pit only 10-ft 6-in. deep. This feeder is driven from the foot shaft of the elevator used for moving coal into the plant. The other inclined apron feeder sketched delivers up to 45 tph direct to a crusher or through a bypass to an elevator. Pit depth is only 11 ft.

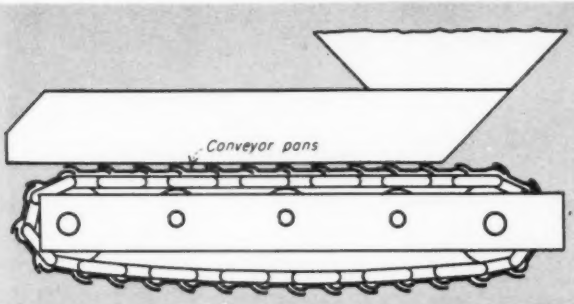
Bar-Flight Type. Where pit depth must be held to a minimum, the bar-flight feeder serves well. Drawing above shows one in a pit about 2 ft deep, delivering 20 tph at 20 fpm. This type of feeder is a double-strand flight conveyor with shallow flights. Bottom run carries coal and top or return run is shielded to direct flow to lower run.

With the exception of the bar-flight type, which is best suited to smaller capacities and narrow hoppers, apron feeders can have large areas, permitting large openings from track hoppers to conveyors. This, combined with agitating tendency, is considered good insurance against coal sticking.

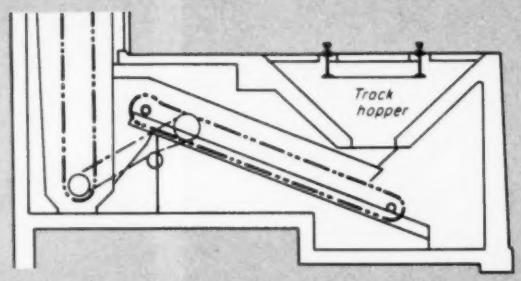
Reciprocating Feeders. This type agitates incoming coal, working against hangups in the hopper. Of several designs, one illustrated above is common for coal feed from hopper to crusher or conveyor. It consists of a steel plate, 6 to 9 ft long and 15 to 30 in. wide, mounted on tracked wheels between guiding skirt plates. Rods connected to adjustable cranks or eccentrics drive the pan from a motor. As eccentrics revolve they push pan forward with its load of coal. Additional coal falls from hopper to back end of pan, filling space left by that carried forward. On return stroke, coal doesn't move back with pan and some falls off the end.

These feeders do a good job with lump material. Operating speeds range from 10 to 30 fpm, and plate movements, adjusted by crank throw, vary from about 6 to 8 in. Plate width and coal depth set the loading volume rate.

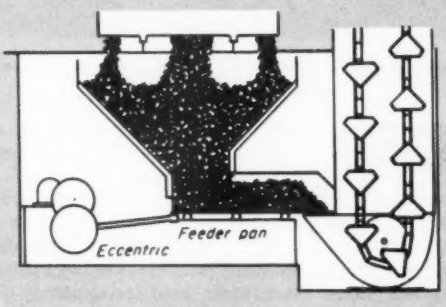
Vibrating Feeders. In this design, a feeding pan attaches to vibrator arms or bars. A laminated armature



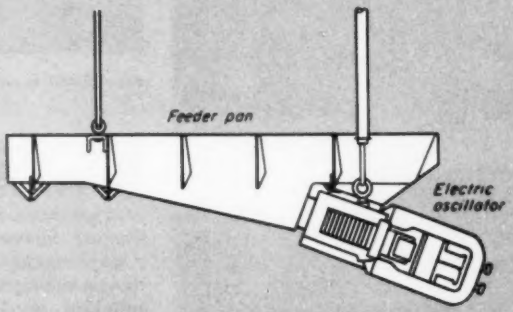
Feeders, like this apron design, control flow



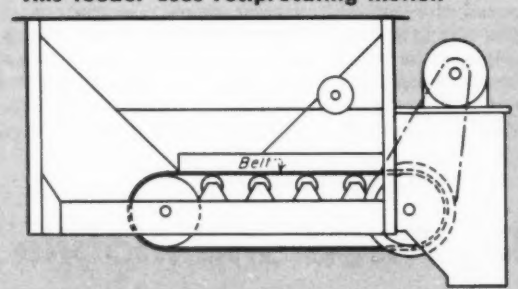
Elevator foot shaft drives this feeder



This feeder uses reciprocating motion



Vibrating feeder is electrically energized



Properly supported, belt conveyor acts as feeder

MECHANICAL FEEDERS like those illustrated here take the coal from its unloading point and deliver it at a controlled rate to the desired pickup point of conveying equipment for moving it into the plant or into reserve storage

. . . for controlled flow to the next handling step

connects to the vibrator bars and an electromagnet is anchored to the main frame. Energized with ac, the electromagnet causes the vibrators to: (1) deflect toward the magnet as current builds up in its coil, and (2) release when current passes through zero. This sets bars, and feeder pan, to vibrating back and forth. Frequency is 7200 vibrations per minute on 60-cycle ac. Although vibrations are so small that feeder pan doesn't appear to be moving, coal flows uphill or down in a smooth stream. Changing slope of feeder or varying vibration intensity changes feed rate.

Vibrating feeders have no parts requiring lubrication and subject to friction wear. Power demands are light. This type has been developed for a wide capacity range.

Screw Conveyors. These units serve quite well in small plants, working on small-lump coals free of tramp iron, wood, etc. They are simple, low in cost, can be built into restricted spaces and can readily be made dust-tight.

A screw conveyor usually consists of a long-pitch steel-plate helix on a spindle carried on bearings within a U-shaped trough. As spindle rotates, coal moves forward under thrust of lower part of helix and discharges through openings in the bottom or end of the trough.

Capacity suffers when helix is inclined. For steep inclines, helix may be given a short pitch and trough made tubular so capacity loss is less. Allowable loading and speed depend as much on nature of material handled as any other factor. For coal, maximum horizontal loading is taken as 38% of helix vertical cross section and speed is from 70 to 120 rpm.

Belt Conveyors. Simplicity, smooth operation and uniform discharge make belt conveyors attractive as feeders. When so used, they're short, with closely spaced idlers for support against impact of hopper-fed coal. Designed for longer runs, belt conveyors find wide use, as we'll see later, for transfer operations and for handling in the plant.

INDUSTRIAL LIFT TRUCK is sometimes used in small plants to transfer coal directly from outdoor storage to firing units

BULLDOZER mounted on a crawler tractor

SCRAPER with rubber-tired prime mover

MOBILE EQUIPMENT

Use of mobile equipment for coal stockpiling has grown enormously in the past 20 years. Reasons are: (1) suitability for building layered, compacted piles (2) adaptability to various site conditions and changes (3) relatively modest first cost (4) possibilities of using equipment for other purposes, such as snow clearing, etc. To the original crawler-tractor bulldozer has been added an array of crawler and rubber-tired equipment.

With either crawler or rubber-tired tractor, the bulldozer fits best for relatively modest production rates on shorter hauls, say up to about 300 ft. Adding wings to the dozer blade raises capacity per push. On large piles, bulldozers are used for dressing, cleanup.

Pulling rubber-tired carry-type scrapers extends the economical work range of tractors. Units of this class can pick up from 10 to 20 tons of coal and haul it well over 1000 feet at relatively low cost (POWER, Aug 1945, p 88). For larger stockpiles (say, over

For the outdoor stockpile: fixed and mobile . . .

Coal storage may be divided into two types according to purpose: *live,* or *active,* storage from which firing equipment feeds directly, and *dead* or *reserve* storage to guard against delays in shipments, etc. Usually, live storage is under cover and reserve storage is outdoors. But in some plants, one storage, covered or outdoor, does both jobs.

So on this pair of pages, and the next, let's look first at outdoor storage, keeping in mind that while it's usually reserve storage it may be live storage as well. That's true in many smaller plants, which may have outdoor storage under a rail-siding trestle or in some corner of the plant yard where trucks dump deliveries. In such cases, and others, industrial lift trucks with scoops (photo above) or specialized motor loaders are used to bring coal from the pile directly into ground-floor boiler rooms.

Stockpiling Equipment. When it comes to outdoor stockpiling, a tremendous variety of means is available. But they break down into two broad classes: fixed and mobile. Perhaps most widely used of the fixed group are drag scrapers. As sketched and discussed at the right, drag scrapers can be adapted to a wide variety of site conditions.

Locomotive cranes, and other types, fitted with clamshell buckets, are used for stockpiling. These can pile and reclaim only a limited distance either side of the track, but track can be looped or paralleled to fit many ground plans. For large operations, gantry or bridge cranes are used, spanning the distance between paralleled sets of tracks and carrying one or more trolleys with clamshell buckets. Such equipment often handles unloading from barges and ships, or railroad cars, as well as stacking for storage.

In recent years, use of mobile equipment has grown rapidly. In this group we have what are primarily earth-moving machines — tractors, bulldozers, scrapers, etc — adapted to handling coal. All they need is an initial pile to work from and a point to reclaim to, both of which are normally provided by the equipment for unloading coal and moving it directly into the plant. Thus mobile methods call for no fixed structures and give a high degree of flexibility in utilizing available ground space.

Type of equipment selected for any given installation will depend on a great many factors, an important one being first cost. The fact that coal-handling equipment is frequently used just one shift per day makes it desirable to keep investment down. But experience shows it pays to mechanize to keep down labor costs, so the trick is to secure the best balance between first costs and operating costs.

Storage Procedure. Where outdoor storage serves as a reserve, normal practice is to take part of incoming shipments directly into storage within the plant and divert a portion to the outdoor pile. As needed, reclaimed coal is routed into the plant. How much transfer between outdoor and indoor storage there is, and how often stockpile coal is reclaimed depends on the nature of the coal and its storing qualities, size of pile in relation to plant use, etc.

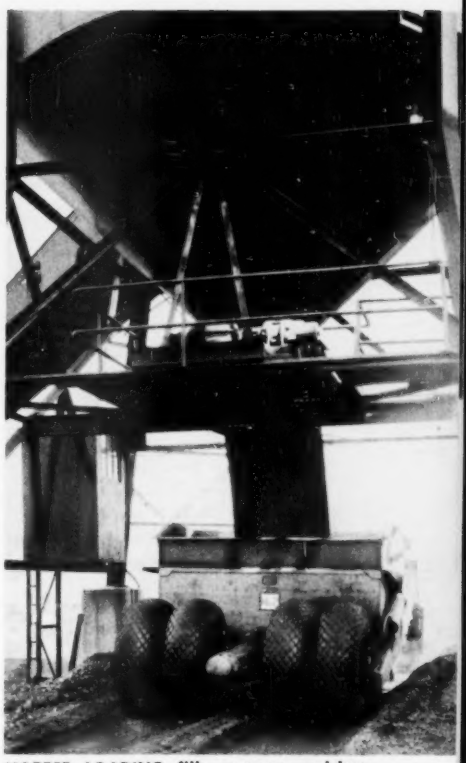
Regardless of equipment used, economical and safe storage calls for know-how. See next spread for the methods.

TWO-ENGINE SCRAPER, rubber-tired and self-loading, fits best in large operations

100,000 tons with piling and reclaiming demands of more than 150 tph) there is now a 2-engine scraper (POWER, Jan 1953, pp 94-96). One engine powers scraper wheels, and the other the tractor-drive wheels.

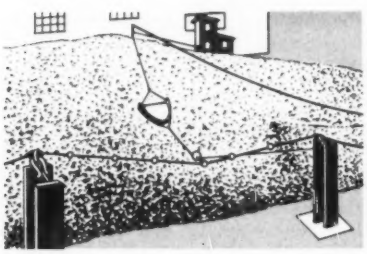
Selecting mobile equipment thus depends on an economic comparison of the various types in relation to the distances involved and the hourly production rates required. The operation is always much the same. For moving coal out to storage the starting point is a "cushion" pile from which bulldozer or scraper can take its load. (Scrapers are also loaded from overhead hoppers for quicker filling.) The cushion is formed in any one of a variety of ways by the conveying equipment working out of the unloading point.

Coal is spread on the pile in thin layers and the normal traffic of mobile units usually proves adequate for compacting. If not, additional trips can be made just for compacting. In some cases, weighted rollers have been used, but this seems unnecessary. In reclaiming operations, the bulldozer or scraper usually unloads to a hopper or pit feeding conveying equipment.

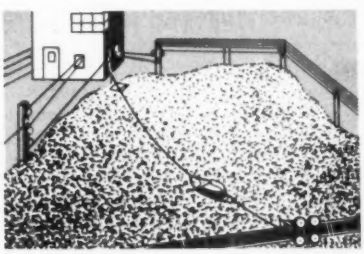


HOPPER LOADING fills scrapers quicker than they can self-load, is sometimes used in larger stockpiling operations

. . . equipment meets varying site needs, but . . .

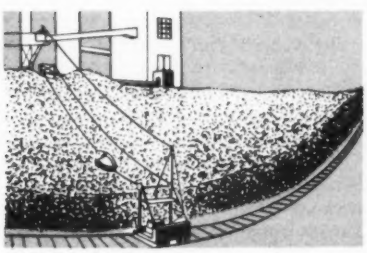


DRAG SCRAPER on back post and bridle

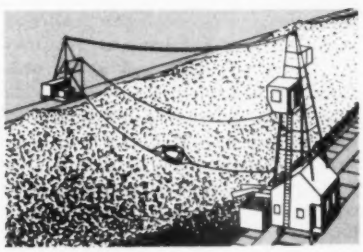


MONORAIL and trolley moves tail pulley

DRAG-SCRAPER LAYOUTS



RADIAL SETUP: back post moves on track



PARALLEL, 2-tower layout for large pile

Simplest drag scraper has fixed back posts. Cable from scraper drive, near head post, passes over one head block, out to scraper bucket, then to tail block and back to second head block and drive. To build pile, bucket works out from initial pile near head post; to reclaim, the bucket is reversed.

Back post height depends on storage depth and distance hauled. As a general rule, back posts run 8 ft tall for 15- to 20-ft storage depth. In this layout, tail block is shifted by hand.

For larger piles and longer hauls, tail blocks are heavier and easier shifting becomes important. One scheme uses a monorail and trolley, with fixed back posts. But in most larger installations, some form of mobile tower is used, often on a radial track. Towers have outriggers and rail clamps, may be shifted manually or may be motorized.

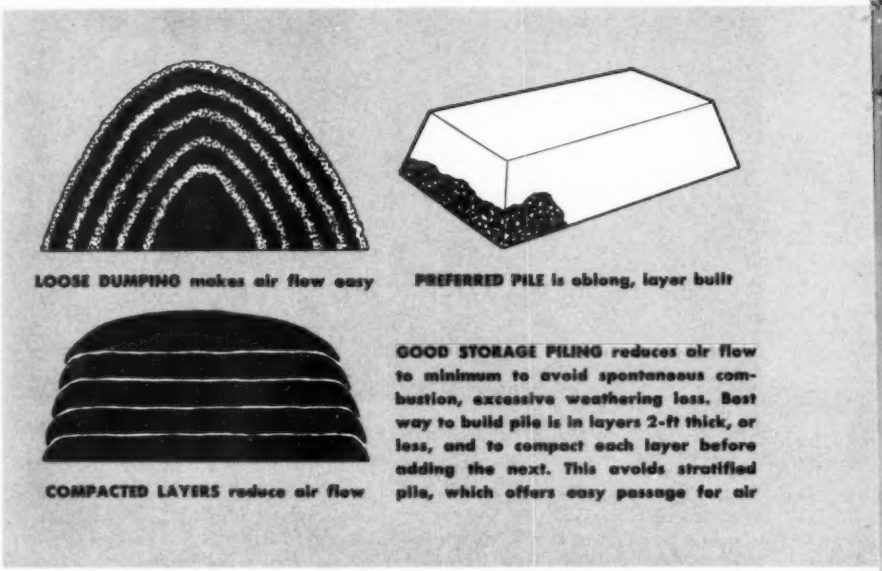
Fully mobile towers have propulsion motors and brakes controlled from operator's cab; two may be used in parallel layout as sketched. For drag-scraper details, see POWER, May 1946, pp 66-69, and July 1946, pp 74-75.

STORAGE LOSS IS SMALL

Most coals may be stored for long periods without serious loss of "quality." Tests show loss of heating value doesn't usually exceed 1% the first year, except for low-rank coals, which may lose up to 3% in first year.

Weathering tends to make most coals "slack," that is, causes a reduction in size or crumbling. Slacking is greatest for low-rank coals and near storage-pile surfaces. There is also some possibility of loss of "caking" and ignition qualities. These effects are usually negligible.

So, when it comes to outdoor storage, even for long periods, your primary concern is to guard against heating and "fires," (see below).



LOOSE DUMPING makes air flow easy

PREFERRED PILE is oblong, layer built

COMPACTED LAYERS reduce air flow

GOOD STORAGE PILING reduces air flow to minimum to avoid spontaneous combustion, excessive weathering loss. Best way to build pile is in layers 2-ft thick, or less, and to compact each layer before adding the next. This avoids stratified pile, which offers easy passage for air

...safe storage depends on proper piling methods

Today, more plants than ever find it smart to stockpile coal outdoors. It's always been necessary for some — plants along waterways subject to freezups, for example. But supply and transportation dislocations during war years and strikes have led many others to follow the practice. Even aside from the emergency reserve angle, there's often sound economic sense in being able to buy coal during "off" seasons.

Safe Storage. Whether your storage is large or small, you want protection against loss by weathering and by spontaneous combustion. And if methods now well-known are used, outdoor storage, even in large amounts and for long periods, can be practical and safe.

All coals tend to combine with the oxygen of the air. Frequently this is an extremely slow process, often called weathering. There's some loss of heating value and change in firing characteristics. But if conditions are right, the action can move faster and we have heating or spontaneous combustion. Knowing what causes this is the key to avoiding storage-pile fires.

Coal-Pile Heating. When coal combines with oxygen, heat is given off. If heat isn't carried away, temperature rises. As it does, the reaction with oxygen, like all chemical reactions, speeds up. So we have a vicious circle — heat, temperature rise, faster reaction, more heat, higher temperature, still faster reaction, etc, until the coal actually burns in the normal sense.

There are two basic ways of combating this action. We can make sure that air moves through the pile fast enough, and uniformly enough, to carry away heat without appreciable temperature rise. Or we can try to cut air flow through the pile to a minimum to reduce possibilities of reaction.

Storing Sized Coal. What might be called the free-air-flow method is the simplest but is limited in application. Only with sized coal, which leaves more or less uniform air passages in the pile, can we depend on this scheme. In smaller plants, particularly the few remaining hand-fired ones, this works well. But larger plants rarely buy double-screened coals, and if fines are present it's necessary to use methods that cut air flow to a minimum. Let's see why this is so.

Avoiding Segregation. If fines are present as well as coarse lumps, we run into the problem of *segregation*. This affects other parts of the handling and firing system but right now we're concerned with its effects on storage. If, in the ordinary way, we dump coal on a pile, the fines tend to stay in the center and the coarse lumps roll to the outside. Such segregation in a coal pile gives areas or lanes where air flows readily and others where it hardly flows at all. Somewhere in such a pile, we're sure to get just the right combination of air flow and heating to produce spontaneous combustion. So the first step is to avoid segregation.

Best defense against segregation is layer piling. To build a layered pile, spread the coal thin over the storage area. Where coal is dumped from buckets, redistribution may be necessary. With equipment like drag scrapers, bulldozers, rubber-tired scrapers, layer piling is merely a matter of proper procedure. Even trucks can be used to build a layered pile (POWER, Nov 1942, p 68). Regardless of equipment, the important thing is to build the pile in successive layers and to keep them thin — less than 2 ft, with 6 to 12 in. being best practice.

Compacting. Such piling tends to mix coal, eliminate segregation. But for troublefree storage, we'd like to pack the coal tightly to cut air flow through the pile to a minimum. Loose coal, for example, has a density of about 50 lb per cu ft. In ordinary storage piles, density builds up to some 58 lb per cu ft at the bottom of a 20-ft-deep pile. By *compacting*, we can raise density to 65 or 70 lb per cu ft.

Compacting goes naturally with layer piling. Each layer can be tamped or rolled to pack it down. Usually, weight of equipment used to spread coal proves adequate. Bulldozers and scrapers, for example, do an excellent job of compacting.

A word about coal sizing is worthwhile here. Don't compact sized coals without fines. Double-screened coals should be stockpiled separately, by the free-air-flow method. Where coal is

WHEN YOU START TO BUILD AN OUTDOOR STORAGE PILE:

DO

Select a well-drained area for coal storage, free of standing water. Best site is raised, not subject to flooding from nearby streams or runoff from adjacent ground

If well-drained area isn't available, install drainage ditches, running length of site along the sides

Make certain ground is solid, not loose and porous and not cinder fill. If possible, grade to uniform level. Sometimes storage areas are top-dressed or hard-surfaced with paving materials

Build up pile in successive layers, not more than 2-ft thick and preferably less. Wherever possible, compact each layer

Dress pile by sloping tops of successive layers and top of completed pile toward sides, to prevent rain or melting snow and ice accumulating and penetrating into the pile

Make periodic temperature checks of the pile, particularly at edges and side slopes. Remember, 160 F is critical temperature

Seal pile as far as possible. A 6-in. layer of fines, anchored against wind erosion by a carefully placed coarse layer, is good

DON'T

Never leave refuse, wood, straw, growing vegetation or any other organic material standing in an area you select for coal storage

Don't pile coal around steel or wooden posts, crane supports, etc. Pile density is bound to be lower around these elements than in the pile proper, providing vents for air and gas movement

Never attempt to ventilate a pile with pipes or wooden ducts for the same reasons you avoid piling coal around uprights (above)

Don't store coal near steam pipes, smoke stacks, boiler blowoff lines, heated elements of any kind

Don't just dump coal on pile. Dropped coal segregates, forming natural flues for air movement through pile

Compact unsized coal only. Sized coal stores well but not by compacting method. If you store sized and unsized, keep separate

Where you can't compact, and coal isn't sized, avoid conical piles by dumping in small continuously overlapping piles

Don't make pile sides too steep. Keep below 45 deg, with 30 deg a good slope to aim at. Steeply sloping sides risk segregation

If you locate a hot spot, or have a fire:

(1) cut away or isolate heated coal (2) recompact pile, starting at edges and working inward (3) if pile is small and area permits, move coal and respread it (4) try feeding CO_2 into pile, using pipe fitted with well-drilling points or with holes in flattened end

In cutting away heated coal, don't disturb remaining coal. Don't apply water to heated area. The fire may appear to be quenched after soaking, but you set up conditions likely to produce a recurrence of the heating within a very few days

received run-of-mine, crushing before storage is the usual practice.

Properly piled and compacted, coal stands with hard vertical walls when excavated. The pile itself is firm and hard and water runs off slopes. Yet the slopes are the weakest zone. Segregation is apt to be present in side slopes and wind can force air into sides.

Sealing the Pile. Slopes can be safeguarded in several ways. Where mobile equipment is used for piling, bulldozers should be run up and down side slopes as the pile is formed. This compacts slopes but means a relatively shallow angle, which is a disadvantage if area is limited. You can, of course, surround pile with embankments or store coal in a basin with protected sides. But this raises problems in reclaiming stored coal.

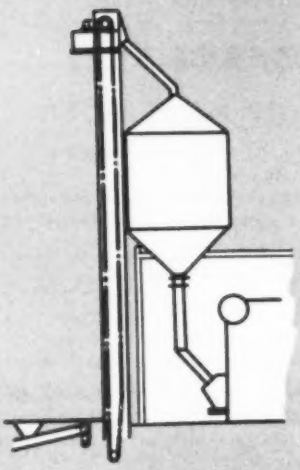
Sealing the exterior surfaces of the pile is probably the best all-round answer. Asphalt and other coating materials are used, but general practice today is to seal with a layer of fine coal, 6 in. or so thick. A carefully placed layer of coarse coal anchors the fines against wind erosion.

If Pile Overheats. A properly built and sealed pile should give no trouble, but you shouldn't just forget it. Probe the pile regularly to check temperature. If it gets up toward 160 F anywhere, you've got a bad spot. Don't try to put out the fire with water. It can stop heating only if it reaches just the right spot and is apt to cause problems of its own. Extra compacting in the heating area may cut air flow enough to throttle the reaction. But best plan in most cases is to remove affected coal without disturbing the remainder. Spreading the heated coal will usually put out the fire. Normally, it's better to use coal you salvage from an overheated area rather than try to repile it.

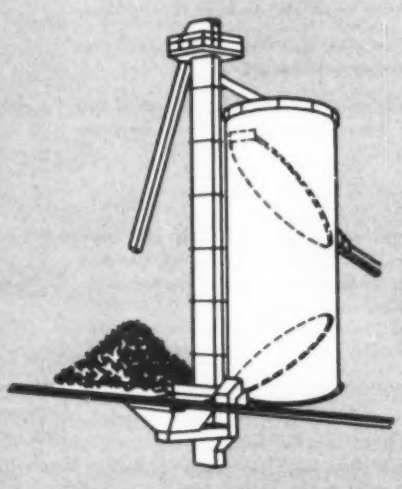
Some users have been successful in putting out coal-pile fires with CO_2. A pipe fitted with a well-drilling point is driven into the pile and CO_2 allowed to bleed into the affected area. If driller's points aren't available, end of pipe can be crushed and holes drilled in it. Similar methods have been used in fighting bunker fires and some bunkers have been fitted with piping and deflector plates for CO_2.

Coal Selection. Four substances seem to contribute most to the reactions involved in weathering, heating and spontaneous combustion — iron pyrites, water, oxygen and certain of the hydrocarbons. Theory says iron pyrites, water and oxygen combine to form iron sulfate and sulfuric acid in an endothermic reaction. This triggers carbon and hydrocarbon reactions with oxygen. Normally all that happens is weathering but, as we've seen, if air in the right amount feeds this reaction, and heat speeds it, we have trouble.

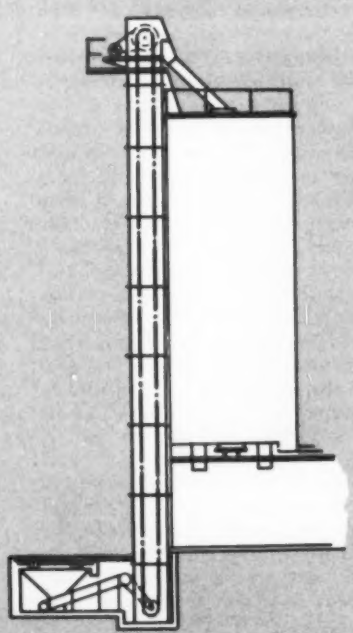
Today's cleaning and washing equipment at the mines removes a portion of the iron pyrites (what often constitutes the coal's sulfur content) and some seams run low in sulfur anyway. From the storage angle, this points to selecting a coal comparatively low in iron sulfides or iron pyrites. Yet it usually isn't practical to select coal from the storage viewpoint, and more often the problem is to store the coal we have or normally receive. So, in the last analysis, proper storage methods are the answer when you must stockpile coal for long periods outdoors.



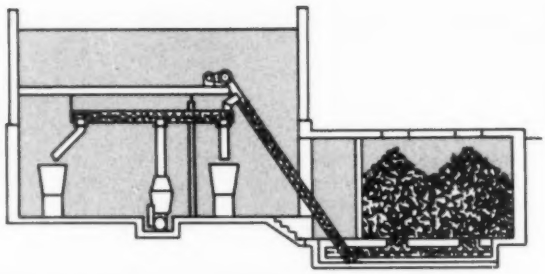
Cylindrical steel tank



Silo: live and dead storage

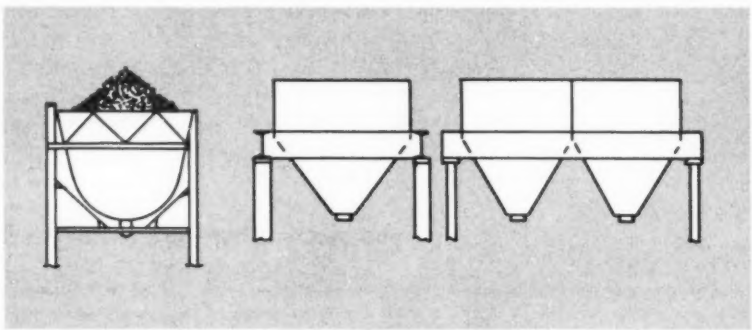


Silo: single storage space



TYPICAL BIN ARRANGEMENT

Small plants, particularly in city locations, often use basement bins into which trucks dump directly. Simple conveying system moves coal from bin to firing units. If coal is sized, or turnover is frequent, there are usually no storage problems



TANKS AND SILOS

Outside-the-plant storage structures include cylindrical steel tanks, silos. Silos may have live and dead storage, *center*, or single storage space, *below*

HORIZONTAL BUNKERS

Horizontal overhead bunkers often are of suspended construction, *left above*. Multiple hopper-bottom design, *right*, eliminates dead spaces between outlets

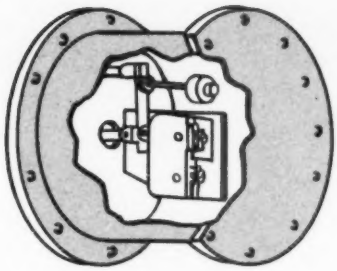
For storing coal under cover . . .

Day-to-day supply for firing units nearly always comes from covered storage — bins, silos, bunkers. Sometimes these units provide the only storage so there is no separate reserve. Or, as in many silos, live and dead storage are included in same structure, but physically separate.

Capacity required often dictates type of storage unit. For small plants, the simple bin may serve. Larger capacity needs point to use of tanks, silos and bunkers designed to save ground space and give more convenient flow to firing units. Outside-the-plant structures include cylindrical tanks, and silos. Steel tanks, like the one pictured above, left, serve for storage up to about 100 tons where roof location is attractive. Silos, usually sized to hold a week's supply, are rarely used for less than 100 tons.

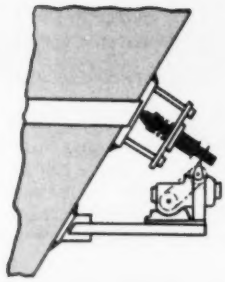
Silos. Often attractive costwise, silos are built of concrete (poured, block or stave construction) and of hollow tile. Usual practice puts a live-storage compartment above, for gravity flow to firing units, and a reserve section below. When live storage is full, coal spills over to reserve, which discharges to pickup point of elevator or conveyor. Thus coal can be fed to live storage directly from unloading point, or from reserve section. With relatively modest live-storage capacity (say, one day's supply) operator can recirculate often from reserve. Live-storage compartment is usually formed by a sloping shelf (about 50 deg). Some silos, however, have a cone-bottom steel hopper for live storage, diameter being about 2 ft less than silo's.

Alternative construction for silos has no separation of live and dead



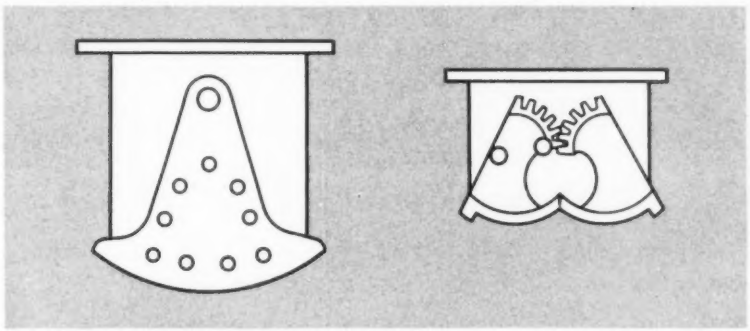
LEVEL ALARMS AND SWITCHES

When coal reaches predetermined level in storage, units, above, sound an alarm or start and stop feed. Each contains a switch, actuated in the unit at left by the pendulum-like device and in the unit at right by a diaphragm on far side of casing



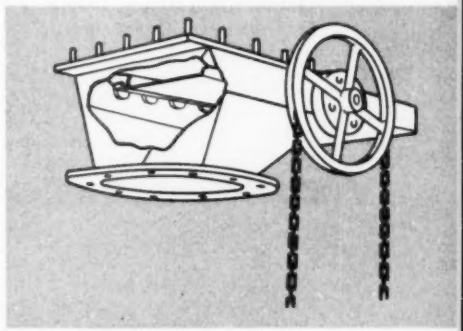
VIBRATORS

Agitation by vibrators, above, or air jets, poking, etc, keeps coal on move, breaks down arching at storage outlets



SWING-TYPE COAL GATES

Discharge outlets of storage units are fitted with gates to control flow of coal. These must open quickly and positively. Gates shown above are of the swing type, the unit on the left being a simplex design and that on the right being a duplex. Such gates are usually made of cast iron to resist abrasive action of moving coal



SLIDING GATE

Sliding design requires little headroom. Protected double rack and pinions drive the gate, which moves on roller bearings in side pockets away from flow of coal

. . . bins, silos and bunkers prove their versatility

storage, and a flat bottom. Unit illustrated, left, has bottom above level of firing-unit hoppers and feeds them by a monorail system.

Suspended Bunkers. Overhead storage units of generally horizontal layout have been built of concrete, masonry and cast iron, but today's common construction is steel plate, often of the suspended design.

In its familiar form, the suspension bunker consists of plates (¼ to ½ in.) hung in a catenary between parallel side girders. Plates are in tension only. To protect against corrosive action of coal, steel bunkers are often lined with concrete or other protective coatings. Another suspended construction has steel straps on about 3-ft centers, acting as bearing members for light-gage preformed steel sheets. These are lined with concrete applied by guniting.

Discharge Efficiency. Horizontal bunkers of suspension and other types have discharge outlets and gates at intervals along the length. Gates, as illustrated above, may be of either swinging or sliding design. Discharge efficiency suffers because of dead spaces between outlets, and trimming these dead spaces can be difficult. One answer is to increase the number of outlets where practical. Another solution uses multiple hopper-bottom construction to eliminate dead spaces.

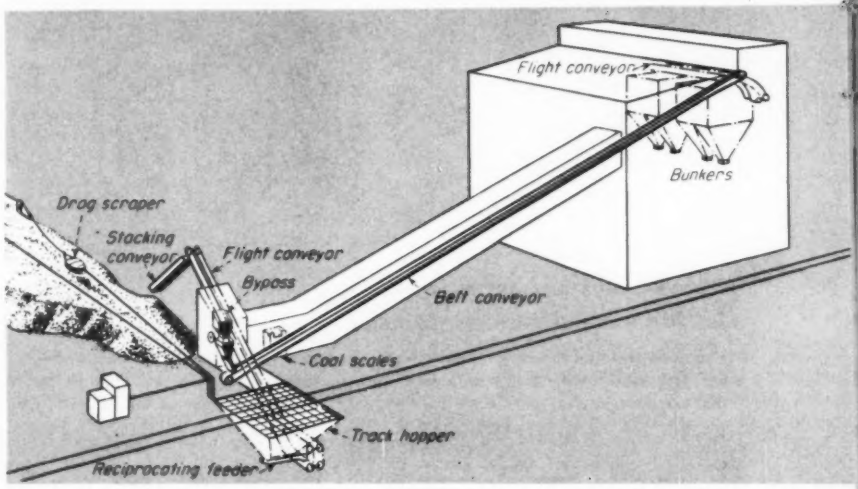
Moisture and compacting can raise coal's angle of repose from about 45 deg to 60 or 70 deg. This may lead to flow problems at storage outlets. Coal immediately above opening drops freely but the remainder arches over and hangs up, stopping flow.

How to Prevent Arching. If a good space above opening can be kept free of coal, say 3 ft or more, arch span becomes too great and flow usually can be maintained. Poke holes, looped chains reaching down to openings, and the modern vibrator all aim at keeping arches from forming. Another approach is to make slopes to outlets steeper. For existing bunkers, this effect can be achieved in some cases by putting a vertical plate above opening's centerline. In new bunkers this is a matter of design — some recommend bunkers with three vertical sides and one sloped.

Crushers. In these pages we've mentioned the common practice of crushing coal before putting it into storage. Limited space makes it necessary to confine this discussion to handling and storing equipment. For a comprehensive roundup on crushers, see POWER, July 1951, pp 73-75; Aug, pp 84-85.

WHAT'S THE JOB?

Diagram of an industrial coal-handling system, right, ties together the functions and equipment we've talked about so far and those still to be covered. Unloading setup is a track hopper with reciprocating feeder. As is common practice, handling system can move coal directly into the plant or can form a cushion pile from which stockpiling equipment works. In the plant there's a horizontal conveyor to distribute coal to the several bunkers. Not shown are chutes and weighing equipment for feeding coal from indoor storage to firing units. Provision is made for a scale.



Next step: Moving coal to and within plant

Thus far, we've taken a look at methods of unloading coal and storing it. Now let's talk about moving coal between the unloading point, storage, and the firing equipment. This may be extremely simple, as in a plant where delivery trucks dump coal in yard storage and a lift truck with a scoop (p 82) takes it directly to stoker hoppers.

Transfer Operation. Handling in most cases is more complicated because we often have both reserve and live storage. Then as a first step (what we called *transfer* in the chart, p 76) we want a conveying system to route coal into either of the storages, or between them. And we have further handling from live storage to firing units (called *in-plant handling* on the chart).

On this spread and the next, we see the conveying machinery that plays a big part in the transfer operation. Then, in following spreads, we consider the chutes, larries, scales, etc, prominent in handling from final storage to boilers. But bear in mind that there's no hard and fast line between — chutes, for example, are used in the transfer stage, and conveyors sometimes deliver coal from bunkers to boilers.

In transfer operations we usually have to lift coal as well as move it. Most conveying equipment will do both, but some designs serve best for vertical or nearly vertical lifts and others for horizontal runs or slight inclines.

Skip Hoists. In its simplest form, the skip hoist consists of a track-guided bucket raised and lowered by a cable from a hoisting machine. Loading takes place at lower end of run, discharge at top. The skip hoist is a tough, durable performer, with few moving parts, suitable for high lifts.

There are three basic forms — uncounterweighted, counterweighted, and balanced. The first, and simplest, sends the bucket up fully loaded and, after dumping, lets it return by gravity. This means braking is needed.

In the counterweighted design, a second cable, wound in reverse direction on the drum, carries a counterweight equal to weight of bucket plus half its load. In either direction, motor load is thus half useful load.

Balanced skip hoists have two buckets operating from one drum and running in opposite directions. This is said to almost double capacity at cost of a similar increase in motor hp but not in hoisting-machine size.

Skip hoists are normally used for essentially vertical lifts but units have been built to run horizontally, distributing coal across bunkers after lifting from ground level.

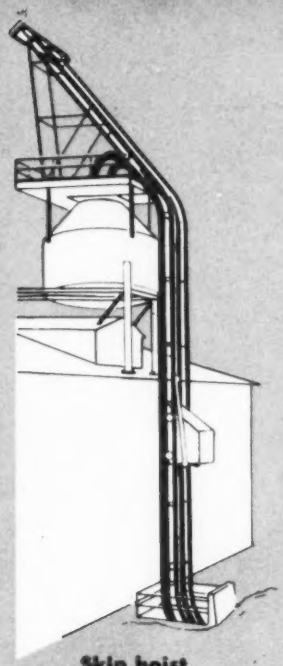
Applying Skip Hoists. Relatively large track hoppers are needed where automatic loaders are used. A 40-cu-ft bucket, for example, would take a hopper 14 x 18 ft and 19 ft deep. This would go to 21 ft for a balanced skip hoist working out of a 14 x 30-ft hopper. Hopper storage capacity is usually at least 20% of skip's rated hourly capacity.

Bucket Elevators. Used extensively for vertical lifts, some types of bucket elevators serve well for horizontal runs also. They consist essentially of relatively small buckets closely spaced on an endless chain, but differ in details of design. Four major types are: centrifugal-, perfect-, and gravity-discharge, and continuous-bucket.

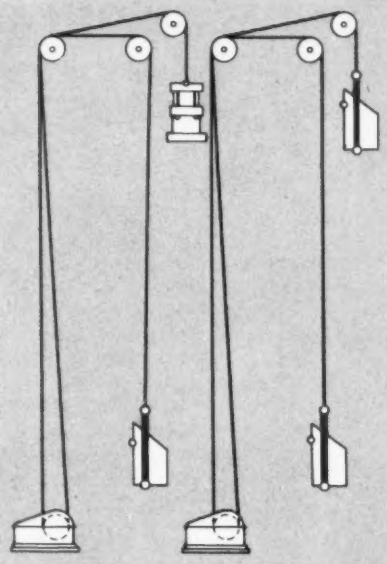
Centrifugal-discharge design has malleable-iron or steel-plate buckets bolted at regularly spaced intervals along a single chain. Incoming coal flows along floor of boot (drawing on facing page) and some of it is scooped up as buckets round the foot wheel, while still more lands directly in the buckets as they enter the loading zone. As buckets pass over the head wheel, centrifugal force unloads them. Design calls for relatively high speed and a close balance between speed, head-wheel diameter, and head-chute position, to keep coal from falling within housing.

Perfect-discharge elevators have the buckets between two strands of chain and use snubbing sprockets under the headwheel to bring buckets into right position above discharge chute. This permits lower speeds yet gives positive unloading. To raise capacity when handling wet coal, buckets are spaced closer or made larger than in centrifugal-discharge designs. Gravity-discharge elevators employ a double strand with spaced V-section buckets. With this design, a vertical lift may be followed by a short horizontal run.

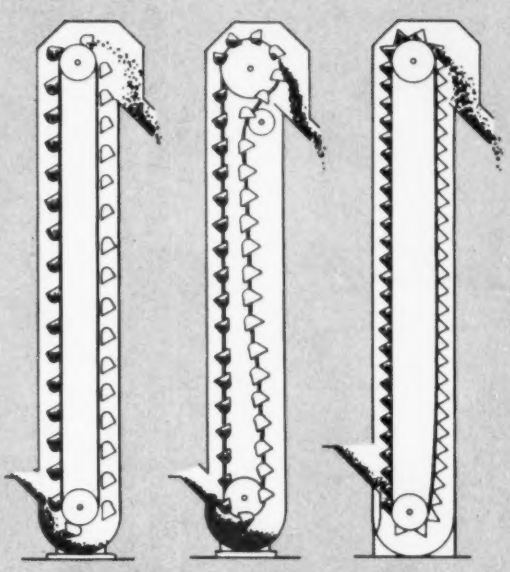
Continuous-bucket elevators deliver good capacity at about 60% of the top speed of the spaced-bucket types (150 rpm) and can handle larger lumps. Buckets are shaped so that as they pass over the head wheel, the discharging bucket can use the flanged back of the preceding one as a chute to deliver coal to the discharge hopper. But this design can do no digging and needs a loading leg, hence



Skip hoist

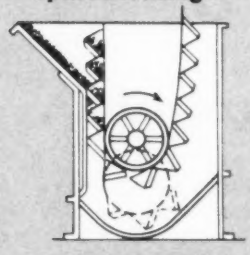


Counterweighting and balancing

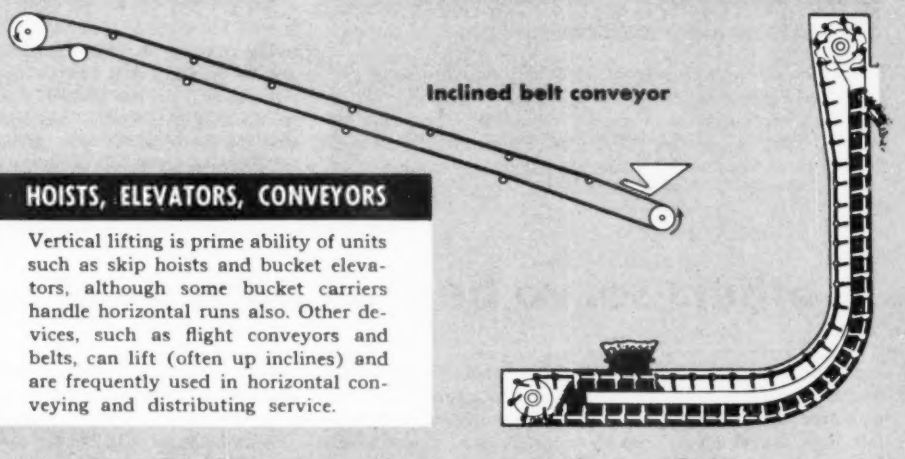


Bucket elevator discharge types:
Centrifugal Perfect Continuous

Spaced loading



Continuous loading



Inclined belt conveyor

Redler-type flight conveyor

HOISTS, ELEVATORS, CONVEYORS

Vertical lifting is prime ability of units such as skip hoists and bucket elevators, although some bucket carriers handle horizontal runs also. Other devices, such as flight conveyors and belts, can lift (often up inclines) and are frequently used in horizontal conveying and distributing service.

needs greater headroom and a deeper boot. Boot should have cleanout doors for removing any coal dropped.

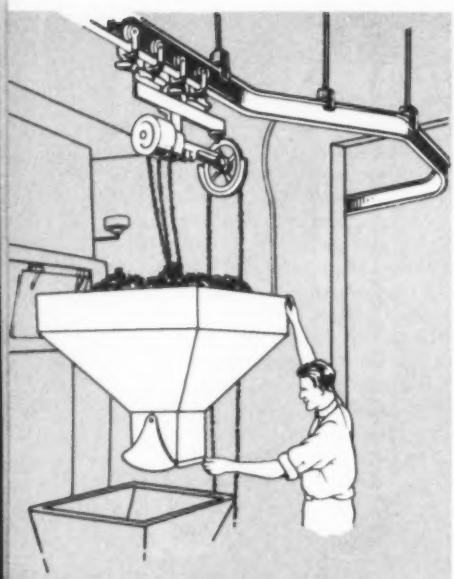
For large-capacity handling of run-of-mine coals, the supercapacity continuous bucket feeds at inclines of 35 to 70 deg. It usually works at low speeds, under 150 rpm, to reduce impact and wear under heavy loads.

Horizontal Runs. As illustrated on the next spread, certain types of bucket elevators – gravity-discharge and pivoted-bucket – can serve as horizontal distributing carriers as well as vertical lifters. We've already mentioned the gravity-discharge type and noted it can handle short horizontal runs after the vertical lift. On the horizontal run, buckets act as pushers, propelling coal forward in a steel trough. Gates at bottom of trough permit discharging coal.

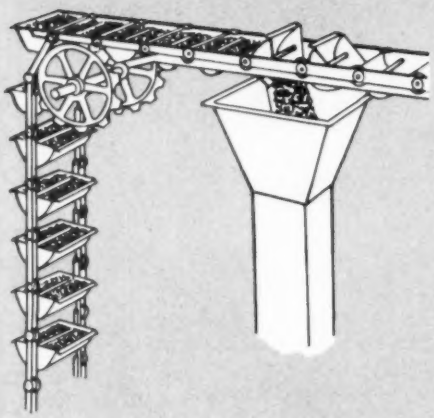
Pivoted-bucket or Peck carrier can be arranged in a complete run-around path. This feature found considerable favor when used to distribute coal to bunkers of boiler hoppers on the top horizontal run and to remove ash on the bottom run. The ash-removal angle must now compete with modern hydraulic and pneumatic methods.

In the Peck carrier, buckets hang from cross rods between two endless strands of roller chain. Chain and buckets are so arranged that buckets overlap automatically on horizontal runs. Buckets always stay upright because center of gravity, empty or filled, is below pivot line. Dumper, or tripper, may be stationary or movable.

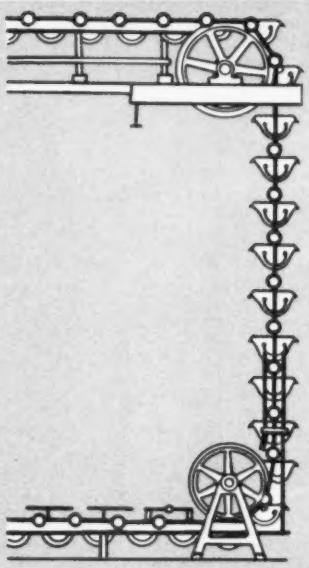
Some units lift vertically or on an incline . . .



Monorail and hopper



Pivoted-bucket elevator



Closed-circuit layout

MONORAILS, BUCKET CARRIERS, BELTS

Some idea of the wide variety of conveying equipment can be gained by looking at designs illustrated here, plus those on the preceding page. Here we have, *left*, the monorail carrier, used in smaller plants for essentially horizontal distribution, from bin to stoker hoppers, for example.

The pivoted-bucket or Peck carrier, *above*, serves equally well for vertical and horizontal runs. It was once extensively used in a closed-circuit arrangement, distributing coal to bunkers or hoppers along the top run and handling ash removal on the bottom run. Gravity-discharge bucket elevators, *right, above*, can handle short horizontal runs after the vertical lift.

Two popular units in today's plants are the flight and

. . . others serve best on horizontal runs, and . . .

Flight conveyors, like elevators, use endless chains but have spaced scrapers or flights to push or drag coal along a trough. In simplest form, they can be several hundred feet long, travel up inclines of as much as 25 deg without backward cascading of coal. Above about 40 to 45 deg, capacity loss becomes too great. A typical 2-chain conveyor of this type handles 250 tph at 100 fpm. Discharge may be at end or at intermediate points through gates in the trough. On horizontal runs, flight conveyors require little headroom.

Continuous-flow or Redler design employs a duct within which closely spaced skeleton flights act as the conveying element. The conveyor feeds itself at any point with a uniform load that fills the duct and entirely surrounds the conveying element. When the flights move they cause the material to flow upward or forward with them in a solid column. Coal can be discharged at any opening where it can fall away from the flights.

The Redler type requires no deep loading pit, only enough room for gravity feed. Skeleton flights are detachable from the central chain. Connecting joints are flexible, to permit moving around corners. There is normally no metal-to-metal contact in the carrying run since coal completely surrounds the flights. Casings are dust-tight and connections can be made dust-tight also. This design serves equally well for horizontal, vertical or inclined runs.

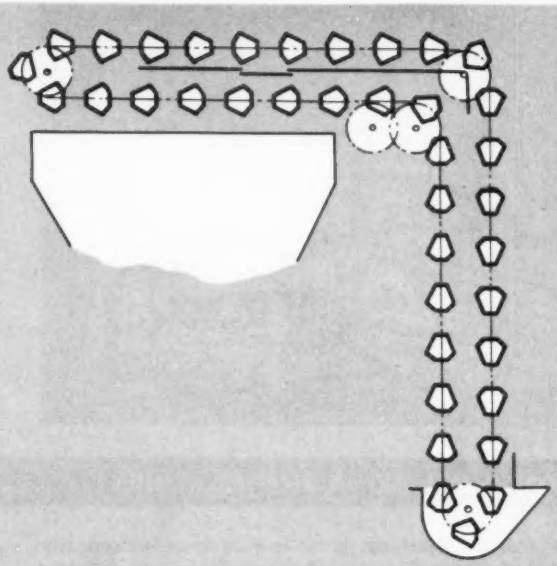
Belt Conveyors. Relative simplicity, few moving parts, minimum friction and hence low power needs, make belt conveyors a popular choice. In comparing belts with other conveyors, however, supporting bridge, sheathing, walkways etc, must be reckoned in the cost.

With belts, as with bucket elevators, only relative motion between coal and conveyor occurs at loading and discharge. But this holds true for belts only up to an incline of roughly 15 to 20 deg. By varying belt width and speed a wide range of capacity needs can be met. Belt conveyors in horizontal runs need little headroom except for trippers.

Simple construction of the belt conveyor involves carrier or troughing idlers and return idlers. Carrying idlers are almost always of the 3-pulley type. Spacing and diameter of idlers is important: too much space leads to belt sag and shock as it meets each roll. If idlers are too small, belt bend is sharp. Either reduces belt life.

Most belt wear, though, develops at the loading point. So every effort goes into reducing shock there. Oncoming coal is accelerated in direction of belt movement to lower relative motion between coal and belt. Coal should never land directly over a solid pulley; hammer-anvil action wears belt. Hence loading chute should deliver between idlers preferably, but far enough ahead of tail pulley to put in at least one belt-steadying carrier pulley.

Weather, cuts, gouges prove worst enemies of belts. Fabric exposed to weather absorbs moisture if protective cover is gone. In warm weather mildew and rot may set in; in cold weather ice crystals may gnaw from within as belt flexes.



Gravity-discharge elevator with level run

belt conveyor, *right*. Drawings illustrate basic flight and belt construction and the trippers and shuttle conveyors used with belts for horizontal distribution.

It is common practice to equip belt conveyors with magnetic pulleys to separate tramp iron from coal before delivery. In addition to the electromagnetic designs, permanent magnets have come into use. Magnetic separators are sometimes used at other points in the handling system.

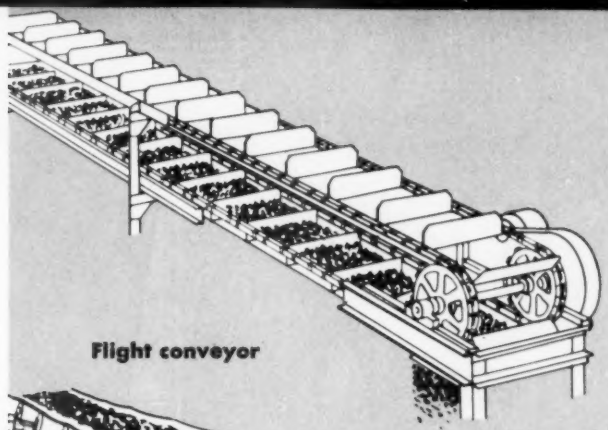
. . . many do both jobs

Simplest discharge setup is from the end. When distribution along belt length is needed, as over a long bunker, trippers are used. These may be fixed or movable. In the movable type, snub pulleys that bend back the belt for discharge at the tripper are mounted on a hand- or motor-propelled frame riding on a runway. When it is necessary to pile coal either side of a conveyor, a high tripper discharging to a transverse reversible belt can be used. Such heavy trippers are almost always motor-propelled.

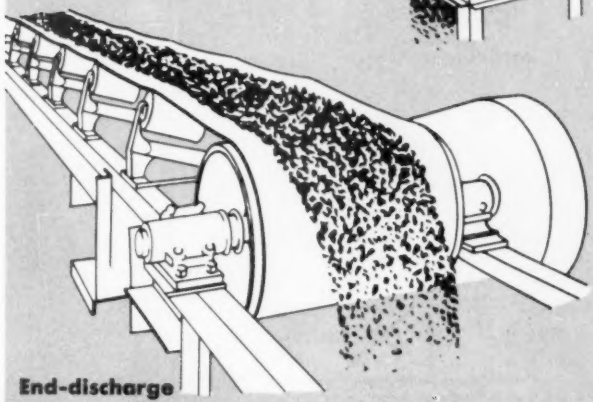
Another distribution scheme uses the shuttle conveyor. It consists of a reversible belt mounted on a frame for longitudinal travel; the frame is hand- or motor-propelled. Coal can be discharged from either end. A shuttle with about 75-ft centers will cover up to 160 ft from a loading conveyor midway in its length. Short shuttles suffer from frequent impacts per unit of belt length.

Screw Conveyors. In smaller plants, screw conveyors, mentioned before as feeders, often serve. Inclined units lift coal to storage bins and frequently directly to stoker hoppers. Horizontal screw conveyors are often used as bin-to-stoker feeders. Simplicity, dust-tightness and compactness make the screw type attractive.

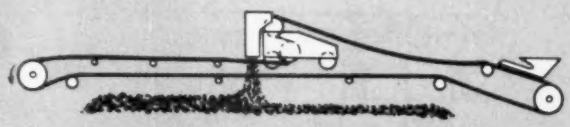
Monorail systems are also used in smaller plants for horizontal movement – often from bunker to individual firing units. Hand-operated systems have tip-over buckets on chain hoists. Carriers may be motor-propelled, with electric hoists and side-dump buckets. Scales may be built-in.



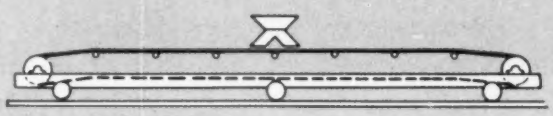
Flight conveyor



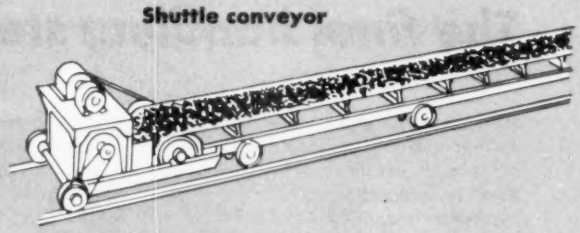
End-discharge belt conveyor

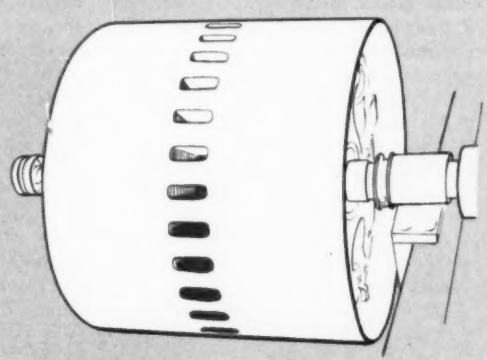


Movable tripper

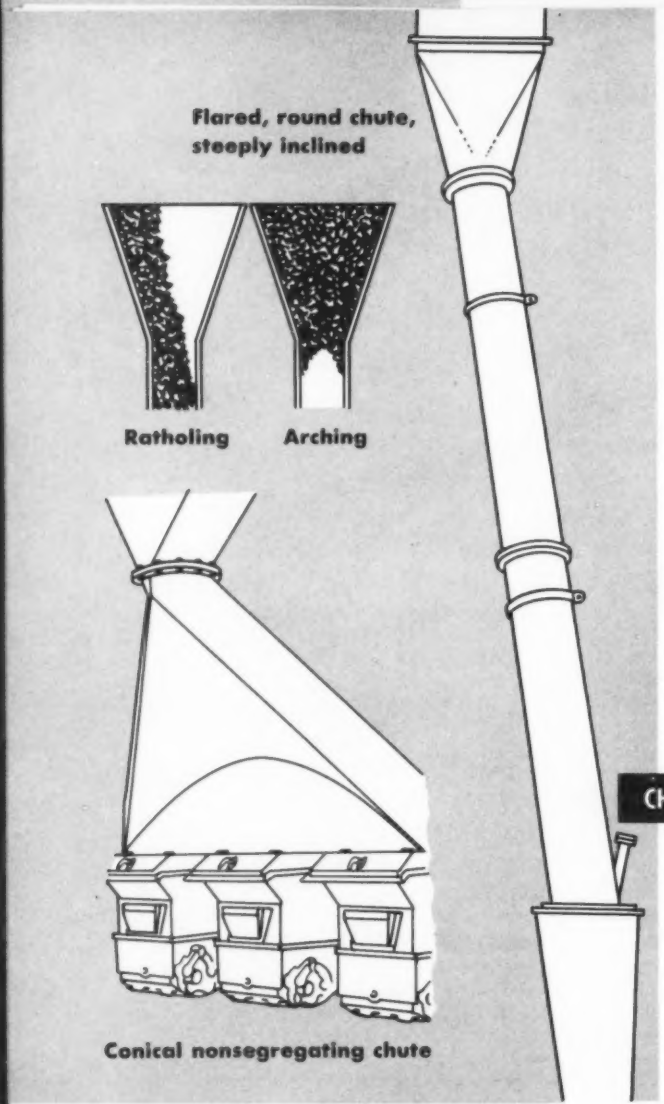


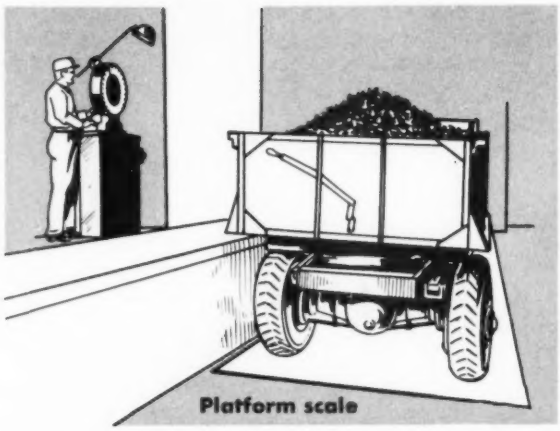
Shuttle conveyor





Magnetic pulley for belt conveyor





COAL IS WEIGHED AS RECEIVED, DURING . . .

With fuel a major cost item, keeping track of quantity and quality is important. Total coal received may be weighed at unloading point or somewhere in the handling system, or coal going to individual boilers may be weighed at final handling step. It often pays to do both.

CHUTE DESIGN FOR GOOD FLOW

Ratholing and arching can be particularly troublesome at the final handling step — but proper design of bunkers, chutes and hoppers can lick them. Chutes, like the one at left, should be steeply inclined, preferably round or oval, and should flare in direction of flow (chute shown is 18-in. diameter at top and 22-in. at bottom). There should be no projections into the flow system, and it is desirable to use corrosion- and abrasion-resistant materials to keep the coefficient of friction a minimum.

To avoid segregation in firing-equipment hoppers, the special conical-design chute, *left*, is often employed.

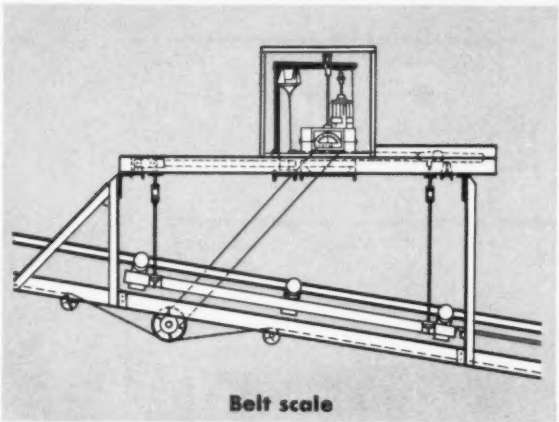
The final handling step, of which weighing is . . .

In the final handling stage — from live storage to firing equipment—conveying equipment just described is sometimes used, to feed any firing unit from any bunker section, or to transfer coal from one bunker section to another. But in most plants, discharge from bunkers is handled by chutes. Apparently simple, chutes can give rise to flow troubles unless properly designed. Recent studies (POWER, June 1953, p 92; Aug 1945, p 79) yield practical tips.

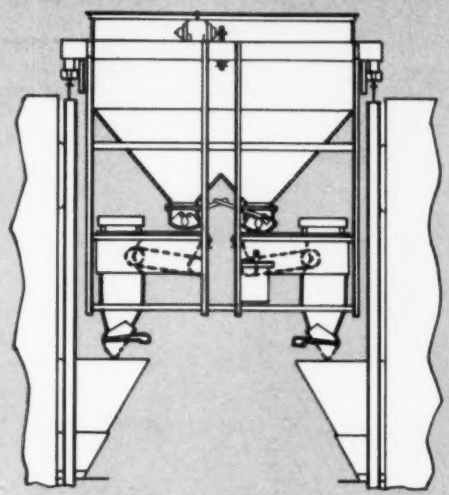
Chute Design. Diagrams and caption above show some features of good practice. Also, chutes should change direction gradually, with, if possible, a *breakaway*, or larger-area section, to give coal a chance to realign itself. Where two streams of coal meet, keep angle of convergence to a minimum. Avoid constrictions, cramped layouts.

Segregation. In talking about storage, we stressed the need for avoiding segregation — the tendency of fine and coarse particles to go their separate ways. This same problem crops up between storage and firing units. How serious it is depends on how much segregation the handling system produces, and on the firing equipment. Segregation can cause size of coal fed to pulverizers to change from minute to minute. Usually more serious is the effect on stokers, where segregation that reaches the fuel bed sets up big differences in resistance to air flow and an extremely spotty fire. First step, of course, is to avoid, if possible, handling-system conditions that cause segregation. Final answer, however, seems to be some form of special nonsegregating chute.

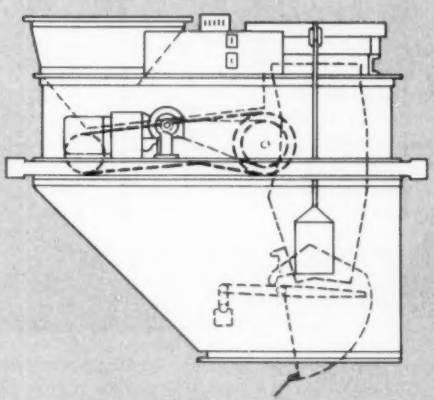
Checking Coal. A frequent part of in-plant handling is keeping tabs on quantity and quality of coal fired. Weighing, of feed to individual boilers or of total receipts, is outlined briefly above, with sketches of typical setups. In addition, there are *measuring* devices working on volumetric principles. One has a vane or helix that projects down into the center of a spout and records movement of coal past it on a meter calibrated to read in pounds. Another employs an endless chain instead of a vane. Similar volumetric principle is used when revolution counters are put on stoker shafts and pulverizer feeders. These serve well for a rough check on unit consumption.



Belt scale



Weigh larry



Automatic scale

. . . HANDLING, OR AS DISTRIBUTED

Track scales, often automatic, weigh coal coming in by rail. Truck deliveries may be checked by familiar platform scale, *above, left*. Weighing devices are built into unloading equipment — rotary car dumpers, feeders, etc. — and scales often installed between receiving hopper and conveyor.

Coal is weighed in transit, also. In the belt scale, *above*, the weigh beam connects to a suspended section of the carrying run. An integrator relates running weights and belt travel to record amount of coal being handled.

For weighing coal to each boiler, the time-honored larry still finds use. Suspended from overhead rails or running on floor tracks, it is basically a means of distributing coal. Drive may be by hand or motor. When weighing equipment is added to the basic larry, it may be manual or automatic.

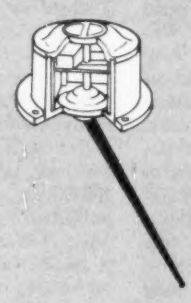
Basic element of many modern systems is an automatic scale of general type illustrated, *right*. Such units are accurate to about 0.5% under average conditions. One shown has multiple-scale lever system with weight carrier and multiple weights, motor-driven belt feeder, hopper and counter to record weighing of preset amounts.

. . . often a part, is important to good operation

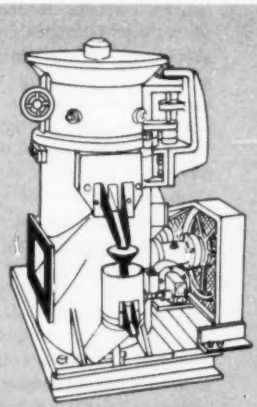
KEEPING TABS ON COAL

Just as scales check coal quantity, sampling for analysis keeps tabs on quality. Process of reducing a gross sample by hand quartering and riffling can be eliminated by using an automatic sampler. Unit illustrated (*far right*) has an additional splitter: it can deliver the normal 5, 10 or 15% sample, or a faster-worked 5% sample of anyone of them.

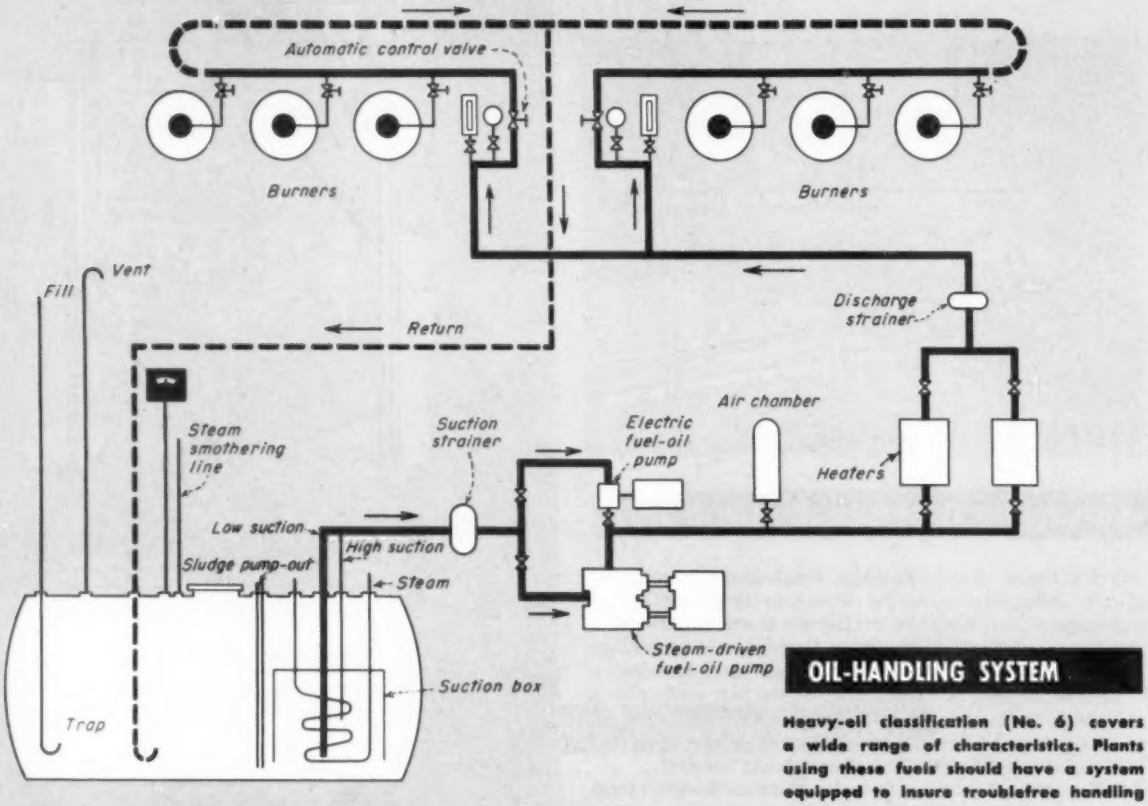
As we've seen, we also want to keep tabs on coal flow and level in bins, silos, bunkers, etc. This applies equally to the final handling stage, where we want to check flow and level in chutes and hoppers. Two units designed for the job appeared on p 87, another is shown, *right*. It has a stainless-steel sensing element, which is said to resist buildup of dust and wet coal. Acting through a spherical pivot and seal, the probe operates a microswitch.



Hopper-level indicator



Coal sampler



OIL-HANDLING SYSTEM

Heavy-oil classification (No. 6) covers a wide range of characteristics. Plants using these fuels should have a system equipped to insure troublefree handling

If you burn oil, here are pointers on tanks . . .

Before setting up a system for storing and handling fuel oil, be sure you are familiar with the recommendations and requirements of the National Board of Fire Underwriters.*And check any local ordinances that may apply.

Quantity of oil stored depends, of course, on rate of use and regularity of supply. Give thought to economic advantages of larger facilities, which permit purchasing when seasonal swings makes prices favorable. But remember that enlarged storage may bring you up against stiffer NBFU requirements and hence greater cost.

Storage Site. Oil arrives by truck, tank car, barge, or, in some cases, pipeline. Usual storage spot is close to delivery point — near rail siding for tank cars, or dockside for barges, tankers. While ideal, such locations may not always prove economical or easy. For example, a waterfront site may turn out to be swampy and require piling to support a large tank.

Some NBFU requirements may also influence tank location. Tank spacings given, on upper part of facing page, may enter the picture. Or decision might be influenced by need for building dikes around tanks holding more than 50,000 gal, or around smaller ones in congested areas. Since diked area has to be capable of holding entire tank contents, land requirements of tank and dike can be considerable.

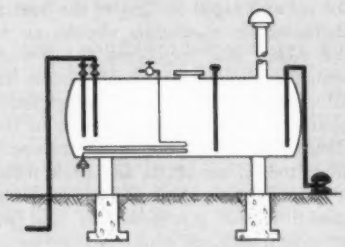
Outdoor Tanks. Typical steel tank constructions are illustrated at top of facing page, and some requirements for aboveground, semi-buried and underground tanks are summarized below them. Tanks are also built of concrete and their design, construction and even concrete mixes are spelled out by NBFU in accordance with standards published by National Fire Protection Assn, *National Fire Codes*, Vol 1, 1951.

Inside tanks should be installed in enclosures whose walls are at least 6 in. thick if reinforced concrete or 8 in. if brick. They should rest on concrete or other fire-resistive flooring. Enclosure top should be reinforced concrete at least 5 in. thick, or equivalent fire-resistive construction, except where floor and roof construction above the enclosure is concrete or similar fire-resistive material. In this latter case, enclosure walls may be bonded to the underside of the construction in place of a separate top. Openings should be of approved type and ventilation provided. Gross capacity can reach 15,000 gal in fire-resistive buildings, 50,000 gal where tank room is cut off vertically and horizontally from other floors of main building.

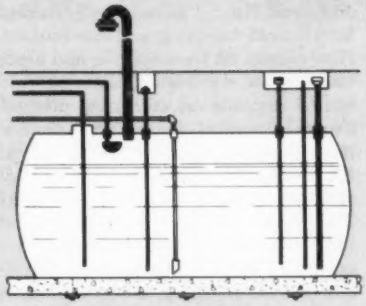
Vents. All fuel-oil tanks must have a vent pipe open to the outside air to let the tank breathe as it is filled or emptied. When oil is pumped from storage, action of atmospheric pressure on the liquid surface helps keep oil flowing to the pump inlet.

NBFU states that vent pipes should be sized to prevent abnormal pressure within the tank during filling and should never be smaller than 1¼ in. for 500- to 3000-gal tanks, 2 in. for 3000- to 10,000-gal, 2½ in. for tanks

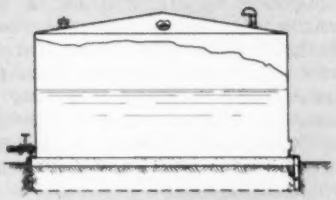
*60 Batterymarch St., Boston 10, Mass.



Outdoor, aboveground storage



Underground storage



Large cone-roofed tank

STORAGE-TANK POINTERS

Smaller fuel-oil tanks may be of horizontal cylindrical construction, usually shipped to plant site completely fabricated. Distance from tank to nearest building cannot be less than 1.5 times greatest dimension, up to 175 ft. A 25,000-gal tank 40 ft long and 10.5 ft in diameter would have to be 60 ft from nearest building or property line. Minimum distance between tanks should be at least ½ greatest dimension of smaller tank. So tank above would have to be 20 ft or more from another tank of same size. Tanks holding less than 18,000 gal, however, need only 3 ft spacing.

Underground tanks face different limits. For example, 75,000-gal tanks require 10-ft space between them and nearest building. Tanks of 150,000-gal capacity need 25 ft, 500,000 gal, 40 ft, and all capacities above that, 50 ft.

Earth cover on an underground tank needs to be 2 ft or more. With a 4-in. concrete slab, earth cover can be cut to 12 in. In all cases, tank must be below any piping to which it connects, to guard against any gravity discharge.

Large above-ground tanks like the 50,000-gal one above are usually cylindrical, often with cone roof. Such tanks are usually erected on the site, hence space must be available for erection work. Distance from nearest building or tank must be at least ½ diameter of tank. Above 126,000-gal capacity, spacing goes up to full diameter of tank.

Semi-buried tanks are also used. They are usually mounded over with side slopes of 1.5 to 1. Recommended 2-ft earth cover is measured at shallowest point. Such tanks find use where water table is high, etc.

. . . pumps, heaters, and piping to hook them up

up to 25,000-gal and 3 in. for those up to 50,000-gal capacity.

Where oil tanks are filled by pumping, a good rule of thumb makes vent at least equal to pump discharge line. If vent is less than 10 ft long, or greater than 2 in. inside diameter, its outlet should carry a vacuum or pressure-relief device, or an approved flame arrester.

Piping the Vent. Vent pipes should (1) drain back to the storage tank (2) connect to tapping at high end of tank (3) never extend more than one inch into tank (4) terminate outside of buildings not less than 2 ft horizontally and vertically from any window or building opening. Put an approved weatherproof cap on top, high enough above grade so snow, ice can't block it.

In addition to normal venting, all above-ground tanks should carry provision for emergency relief to safeguard against excessive internal pressure caused by exposure fires. Venting capacity of normal and emergency reliefs should be enough to prevent rupture of shell or bottom of vertical tanks, shell or heads of horizontal tanks. Bear in mind that responsibility for selecting limiting pressure on a tank rests on the owner or operator.

Fill Lines. Storage tanks for fuel oil should be filled from the outside and in the case of indoor tanks the fill line should terminate at least 2 ft from any building opening at the same or lower level. With tanks that contain heating coils, seal the tank end of the fill line or else extend the fill line to a point below the lower end of the suction line.

Auxiliary tanks should be filled by pumping from main storage tanks and have overflows, at least one size larger than supply pipe, draining to the storage tank. Cross-connections permitting gravity flow are not allowed. Overflow pipes of auxiliary gravity tanks have no valves or obstructions. Those of auxiliary pressure tanks have interconnected valves or other means for automatically venting during filling.

Suction Lines. The storage tank should have suction stubs that are continuous one-piece pipes extending to within 4 to 6 in. of tank bottom. Many use two suction stubs with second terminating 12 to 18 in. above bottom. Second stub provides for pumping clean oil should sludge and water buildup reach lower stub before tank is cleaned. (Cleaning can be done by pumping out or through access manholes built into tank (POWER, Mar 1952, pp 134-135).

Where the storage tank contains a vertical heating coil or suction bell installed through a tank manhole, the heating-medium stubs to the heating coil as well as both suction- and return-oil stubs are welded into the manhole cover plate and the entire assembly is handled as a unit.

Separate Suctions. In installations where two or more burners connect to the same storage tank run a separate suction line to each individual burner. The reason is that no two pumps wear alike and within a short time one pump pulls more vacuum than the other and the burner with

the weak pump becomes hard to start, unreliable in operation.

All burners and fuel-oil pumping equipment require strainers in the suction line to protect them from foreign matter. Perforated-metal or wire-mesh strainer baskets serve for residual oils. It is also customary to install a discharge strainer after the oil has passed through preheating equipment, especially for mechanical-atomizing burners.

Return Lines. Fuel-oil pumps are usually rated to deliver at least up to 1.5 times the burning rate. On so-called one-pipe installations where there's only a suction line, excess oil is diverted from the discharge line back to the suction side of the pump. The customary and preferred procedure is to run a return line back to the storage tank so all excess flows back to tank.

For residual oil this return circulation is highly important. This excess oil already has been preheated and its return to storage raises the over-all temperature at the storage tank, making pumping easier. The return line provides the further advantage of venting the piping system without the aid of special venting valves required with one-pipe designs.

Return-line pipe sizes are usually made the same as for the suction line. When return line rises above the burner on its way to the storage tank a check valve goes in near the burner hinge but there should be no other valves, shut-offs or obstructions. Where there's more than one tank, and you need to install valves in the return line to divert oil to either tank, insert a relief valve in the bypass line.

Valves. Oil supply lines from storage to burner must carry readily accessible shutoff valves of approved type near each burner and close to gravity and pressure supply tanks. Usually they go in on each side of the oil strainers and on the discharge and suction side of oil pumps. If there is one on the discharge side of an oil pump an approved pressure-relief valve should go in to return surplus oil to the tank or bypass it around the pump.

Further, approved automatically operated valves designed to shut off oil in case of breakage of the oil supply line are smart where burners are not equipped to prevent abnormal discharge of oil at the burner. Anti-siphon valves once required by NBFU for this kind of service are no longer a necessity and should not be put in unless local regulations demand it.

A good tight suction line with a check valve near the burner gives a very good guarantee that the suction line will stay filled and the pump will not lose its prime.

Preheating Oil. All No. 6 fuel oils and most No. 5's have to be preheated for efficient handling and combustion. How closely oil temperature, and hence viscosity at the burner, must be controlled depends on atomizing method. For mechanical-atomizing burners, recommended viscosity is 150 ssu at 100 F. Temperature to produce this viscosity depends on the fuel oil used. The Navy rule puts temperature at 125 F plus the saybolt furol viscosity at 122 F. Rotary cup burners handle oils of viscosities up to 300 ssu, while steam- or air-atomizing burners permit an even wider range.

There is a danger of vapor locking in the suction side of an oil pump if all preheating is done before the pump. Top temperature in the suction line should be of the order of 80 to 110 F and no more. For simplicity's sake, many installations have all their preheating on the discharge side of the pump. But often, especially in cold climates, some preliminary preheating has to be done at the storage-tank stage.

Preheaters, or fuel-oil heaters as they are often called, may use steam, hot water or electricity as a heating medium. Electricity serves best for starting up a cold plant.

Preheaters using steam or hot water are of shell-and-tube arrangement with the oil passing through the tubes and the heating medium passing through the shell over the tubes, or vice versa. High-pressure steam plants use steam almost entirely.

But because this steam has a high temperature and can cause coking of the oil and rapid fouling of the heater, thermostatic regulators should go in the steam line supplying the heater, with the thermostatic bulb put in the oil discharge line. As a further safeguard, a magnetic steam valve in the steam line before the regulator opens when the burner starts and shuts when it stops to prevent a build-up of hot steam within the preheater and an attendant extreme temperature rise in the standing oil within the heater.

Where steam supply pressures run above 50 psi a reducing valve to bring it down to 25 psi is good operating practice. The heater installation runs larger and hence costs more but it returns solid advantages in the way of reduced operating costs, less coking of oil, better regulation of oil discharge temperature, greater service and longer life of the fuel-oil heater.

Insulation. Since temperature plays so important a part in the handling and combustion of fuel oil, thorough and efficient insulation of all piping, heaters, etc., is a sensible move.

Materials like 85% magnesia, mineral wool, or asbestos air-cell do a good job on in-plant piping, with plastic cement taking care of the various pipe fittings. Hairfelt and tar paper are often used for underground piping. Frequently the fuel-oil suction line, return line and steam or hot water supply and return lines to the storage-tank heating coil are wrapped together as one bundle.

CHECK POINTS FOR IDEAL No. 6 OIL HANDLING

- **Equipment adequately insulated**
- **Properly sized oil pumps with adequate drivers**
- **Twin strainers for each pump**
- **Suction lines from each pump to storage tank**
- **Automatically controlled fuel-oil temperature**
- **Adequate fuel-oil circulation to insure hot oil to each burner or set of burners**
- **Controlled viscosity by controlled oil temperature**
- **Adequate pressure control of oil to control valves**
- **Ability to condition oil after delivery, before use**
- **Proper instrumentation: thermometers, pressure gages**

How to handle gas economically and safely

A major difference between gas and the solid and liquid fuels is that gas storage is almost invariably the responsibility of the supplier and storage on the consumer's premises is rare. And such large-scale storage of the by-far-and-away most important gaseous fuel, natural gas, is relatively new.

Tremendous expansion of natural-gas use into fields like house heating, etc, has led to a demand that varies seasonally as well as hour to hour. But gas fields and transmission systems can't be operated economically at widely varying rates. As a result, gas is made available at the source at reasonably constant rates, as close as possible to capacity ratings of the lines.

Underground Storage. With virtually no gas-storage facilities in consumer plants, the problem of maintaining high and economical transmission rates in spite of widely varying consumer demand has been solved to an increasing extent by underground storage. In 1952, close to 150 large storage projects, with total capacity of about 1,000,000 MMcf were in operation, from New York to California, Michigan to Texas. In the Appalachian region alone there are more than 100, with combined capacity exceeding 600,000 MMcf. More are planned.

Such underground storages have been developed from depleted or partly depleted gas fields, oil fields, abandoned noncommercial gas fields and formerly untested water sands. Some are extremely large — the Oakford storage field of New York State Natural Gas Corp (near Jeannette, Pa.) holds 1,000,000 Mcf.

Gas Properties. The natural-gas pipeline company customarily conditions the gas to give it qualities and properties that make it more transmissible and more desirable to the customer. Methane and ethane constitute the bulk of the combustibles, methane varying in volume from 60 to 95%. Ethane, propane, butane, hexane, etc, follow in decreasing percentages.

Carbon dioxide and nitrogen form the bulk of the inert portion. Carbon dioxide ranges from a trace, to 100% in some Rocky Mountain area wells, while nitrogen averages out at about 7.9% by volume for the various U. S. fields. Helium also occurs in natural gas but is usually less than 1%.

Some gas fields produce gas containing hydrogen sulfide and the various sulfur compounds known as mercaptans. A gas with hydrogen sulfide is known as a "sour" gas, while one without it is a "sweet" gas. When hydrogen sulfide shows up in a gas it may be from a trace to 10 or 15% by volume. For each 1% H_2S by volume you can figure about 0.1 lb of sulfur per 100 cu ft. Usually, gas when produced is saturated with water vapor at prevailing pressure, temperature.

The gas-transmission company conditions the product by (1) removing water and liquid hydrocarbons (2) taking out hydrogen sulfide and inert gases (3) removing dirt and foreign matter. An odorant is added for safety. The gas reaching the customer is thus nearly all pure fuel and his problem is reduced to delivering this fuel safely to firing units. An example from the setup of a large user (POWER, Nov 1951, pp 90-94) gives an idea of what is involved.

Typical Large System. A typical large-scale user of natural gas gets supply from a pipeline at 100 psi, through a 22-in. line connecting to a

RECOMMENDED PRACTICES FOR INDUSTRIAL GAS PIPING

■ **LOCATION.** Be sure piping is located with safety in mind. Avoid putting it under floors, in unventilated crawl spaces or concealed in solid masonry. If you have to, enclose it in a larger pipe, sealed but provided with means for leak inspections at the inner end of the casing.

Never lay gas piping in cinder fill. Protect buried steel pipe against corrosion by suitable coating, or cathodic means.

Remember that many gases, particularly manufactured, contain moisture. Whether above or below ground, piping should not be exposed to freezing temperatures.

■ **MATERIALS.** Standard-weight (ASA Schedule 40) steel pipe is acceptable and generally used since pressures are relatively low, usually below 25 psi.

In smaller pipe sizes, fittings are screwed type, made of malleable iron, cast or forged steel. Larger sizes (4-in. and over) often use cast-iron fittings but welding fittings and welded or gland-type joints have become quite general. For the latter, check your local gas supplier for gland materials resistant to the gas they furnish.

■ **SIZING.** Estimate maximum rate of gas consumption (cu ft per hr) by dividing equipment input rating in Btu's per hr by the Btu per cu ft of the gas supplied. Load diversity may be figured in, but best practice usually designs pipe for maximum rating, so there is room for growth and changes in specific gravity or heating value of the gas supplied.

Allowable pressure loss from meter to point of use under maximum gas demand can be selected by allowing either 0.5-in. water, or 10% of initial pressure, whichever is greater.

Equivalent pipe length to use in determining pressure loss is taken as actual length plus equivalent length allowances for fittings shown in Table XIV, *Piping Handbook*, 4th ed.

■ **INSTALLATION RULES.** Never weaken the building structure by such shortcuts as notching beams to install piping. Never hang, strap or otherwise support gas piping from other piping or electrical conduit.

Securely fasten and support gas piping with hooks, straps, bands or hangers spaced at intervals no greater than: 8 ft for ¾- and 1-in. pipe, 10 ft for 1¼-in. or larger pipes in horizontal runs; at every floor level for 1¾-in. or larger vertical pipes.

Grade piping with a pitch of at least 1 in. in 50 ft and provide a drip at any low point where condensate could collect. Allow for expansion bends or gland-type couplings in long runs of 4-in. or larger piping. Expansion bends should follow usual good practice for radius, uniformity of curvature, uniformity of wall thickness. Locate gland-type couplings where they can be readily inspected and maintained. (*Turn page*)

twin reducing station in the plant yard. Each of the two reducing valves can handle enough gas at 35 psi to carry top station load. An 18-in. header in the boiler room feeds individual units through 10-in. plug cocks, followed by two emergency shutoff cocks with an automatic vent between them and a manual or automatic gas-control valve operated from the boiler board. This control valve reduces gas pressure to 1 to 5 psi, depending on burner load.

On first starting up with gas, this user took the precaution of blowing the 22-in. main feed line from the gas company's reducing station to the yard reducing station and atmosphere for 7 minutes. Then he purged the line from there to the individual burners, using nitrogen. Considerable foreign material was picked up from the new gas main — enough in one case to cut out the internals of the yard-reducing-station valve.

Gas-System Piping. It can be seen that the basic problem is to install a correct gas-piping system and to operate it properly. To help industrial gas users in this connection, the American Gas Assn formed the Industrial Gas Practices Committee in April 1952. This committee is to prepare a detailed statement of standard requirements for industrial consumers' gas piping.

It is hoped that the committee's work will serve as the basis for an American Standards Assn recommendation for all gas-piping carrying pressures above 0.5 psig. The committee's present thinking was summarized in a paper by E L Spanagel, Rochester Gas & Electric Corp, at the 1953 Fall Meeting of ASME. Much of the material in this paper (*Installation of Fuel-Gas Piping*) is presented on these pages, headed: "Recommended Practices for Industrial Gas Piping."

Standby Provisions. Many industrial-gas consumers take advantage of the lowest rates offered by the supplier, which often are for service of the interruptible type — that is, service may be cut off without notice and restored as the supplier's situation dictates. Plants using interruptible service usually make standby provisions of one kind or another. Often standby fuel is oil.

In many plants, although gas is not used as a boiler fuel, it is used in manufacturing operations, as in printing machinery, heat treating, etc. For such use any standby fuel should be gaseous and should have nearly the same properties as the fuel usually burned so a minimum of adjustments are needed.

Propane, bufane and combinations of them (usually referred to as LPG, for liquefied petroleum gases) are finding increasingly wide use for standby service as well as regular fuel in areas where natural gas isn't available. In the typical standby setup, storage tanks of horizontal cylindrical design are used, with relief valves and extra-heavy pipe and fittings.

An external mixer proportions gas and air to match the physical properties and burning characteristics of the natural-gas supply. Most mixers permit a wide turndown rate, as much as 15 to 1, so load swings should cause no trouble. A vaporizer unit insures that the liquefied gas is properly conditioned for mixing. With such a setup, no changes in settings and burner adjustments are needed. Nor does the gas raise any problems of sludge or gas deposits in the orifices or burners.

RECOMMENDATIONS FOR INDUSTRIAL GAS PIPING, contd

Take branch connections, when needed, off the top or sides of main horizontal pipes rather than off the bottom. This helps to avoid pickup of condensate, scale, rust.

Equip branch connections with suitable manual shutoff valves or plug cocks, placed in the closed position. Close outlets with threaded caps, plugs or flanges until ready to use.

Main shutoff valves on lines to individual buildings should be outside the building to permit cutting off in emergencies. Location should be plainly marked and posted, and provisions made to prevent operation except when authorized.

Gas shutoffs should be gate valves or full-opening plug cocks. Lubricated plug cocks are usually recommended for pipe sizes over 2 in. Where gas pressure runs above 5 psig, tamperproof cocks are a good safety measure.

■ **TESTING PROCEDURE.** Subject the piping system to a test pressure at least 1.5 times maximum working pressure, but never less than 3 psig. System should hold bottled-up pressure for at least 10 min, without drop in pressure after test gas has had time to arrive at ambient temperature. Unusually long piping systems should be tested for longer periods—up to 24 hr.

As test medium, use air or inert gas, such as carbon dioxide, nitrogen or combustion products. Never use oxygen, water or any other liquid.

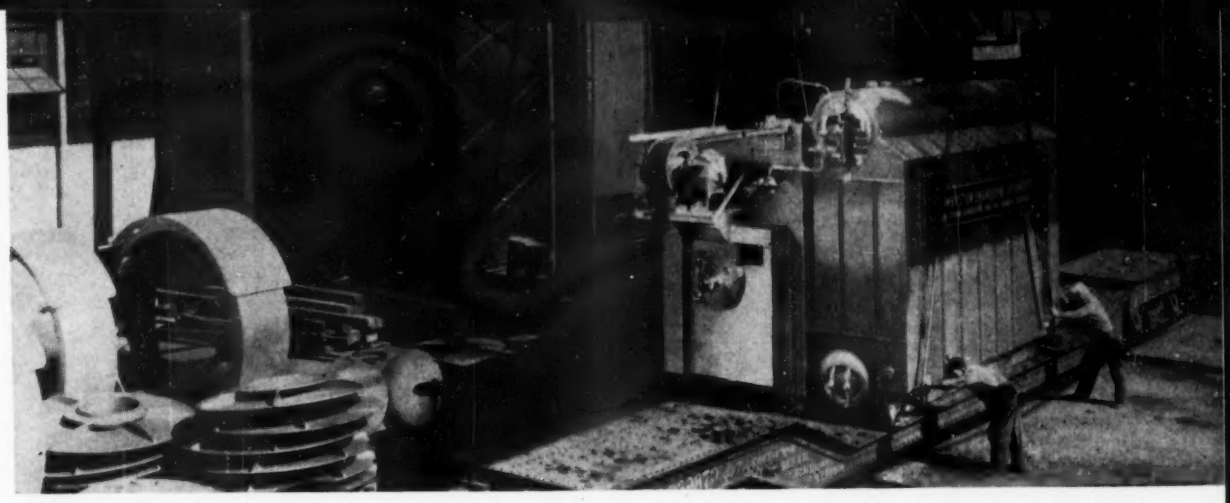
Purge piping after test and after gas meter has been set. Do the purging at the most distant point from the meter, by hose or temporary pipeline leading outside the building. Similarly purge each major branch line.

Make a final check after purging and filling up the gas lines. Test dial on gas meter can be used for over-all leak checks. Observe for 5 min; if there's no movement, consider system tight. If there is, shut gas off at meter and look for open fittings, open ends, open shutoff valves, bad joints.

■ **SAFETY PRECAUTIONS.** Never use gas piping for electrical grounding and never employ piping, control casings, panels or other metal parts in place of wiring. This doesn't apply to the gas combustion system's own low-voltage control and ignition circuits, nor to electronic flame-detection circuits.

Install a backpressure valve wherever air is used for the combustion system at a pressure higher than normal gas pressure. It might possibly back up into the gas lines. Also, put in an automatically operated gas valve with manual reset in the gas-supply line to serve as an interlock between air supply and gas supply. This will prevent flow of gas without accompanying flow of air necessary for combustion.

A second manually reset, automatically operated gas valve should be put in the gas-supply line to close tight at a preset low-pressure limit. Where gas compressors or other devices are installed to raise consumer's gas pressure above that normally supplied, install a similar low-pressure gas cutoff valve with manual reset.



FIELD-TESTED DESIGNS, fully automatic operation, make packaged watertube boilers ideal if they get good water treatment

Packaged Watertube Boiler Treatment

Compact, factory-assembled, packaged watertube boilers feature concentrated water-circulation paths, economy of metal, close tolerances. So steam and water passages must be kept free of scale and corrosion

By **PAUL BRINDISI,**
Chemical Engineer, Celco Laboratories

► WIDE ACCEPTANCE of the packaged firetube boiler set off a strong interest in developing its counterpart — the packaged watertube boiler. Current designs reflect this interest quite markedly. You'll find these new units a sharp departure from the long-established low-head watertube boilers. But because of these design differences they require special considerations for proper water treatment, much as do the packaged firetube designs, covered in POWER, June, p 76.

Design. For years, boiler manufacturers have been making their single- and 2-drum, bent-tube designs more and more compact. Today, they have reached the ultimate. These boilers now leave the manufacturer completely shop-assembled and nearly ready for operation on delivery, photo above. At this early stage of packaged watertube boiler development, units are available for steam capacities ranging from 4000 to 33,000 lb per hr and for operating pressures as high as 400 psi.

The watertube package wholly encases the boiler proper within an insulated sectional-steel jacket, suitable for either indoor or outdoor installation. It requires no special or costly foundation and occupies comparatively little floor space, with low headroom. One or two burners may be employed, firing oil or gas, either alone or in combination. In the single-drum boiler the burner goes in just beneath the steam drum, while in the 2-drum unit you'll find it to the side of the drums, drawings, top of p 101. The integral furnace is entirely watercooled with bare walltubes. However, the single-drum unit has longitudinal sidewall headers on either side of the burner, while the 2-drum unit has none.

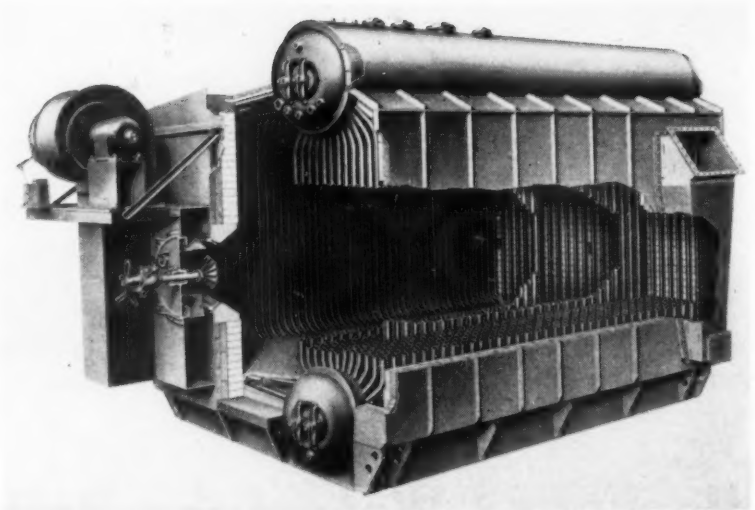
Waterwall tubes of the 2-drum design connect directly from the steam drum to the mud drum. In some designs both drums have identical diameters, while in others the lower drum runs slightly smaller than the upper. These two drums extend the full length of the boiler, but are not always on the same vertical centers. The steam drum of either design generally carries steam-purifying baffle plates or internal separators. In addition, there's usually one blowdown connection from the bottom of the mud drum, about a quarter of the way in from the cooler end. The single-drum design, incidentally, makes blowdown connections to the rear of each of its sidewall headers.

Either forced or induced draft may be provided, although the last named is the more common. Superheat is available, and an external economizer or air preheater can be attached to these units when desired. Installation on the user's premises requires only a simple foundation and the tying of fuel, gas duct, electrical, steam and water connections to ready these boilers for operation.

Gas Travel. The single-drum design has a single, but split, gas pass in which the combustion products return to the front dual-exits by way of side corridors through the waterwalls, right-hand drawing, p 101. Tubes, comprising the cooling bank in front of the rear target wall, are quite widely separated and are staggered with respect to each other. Those forming the side waterwalls are also four or five rows deep, but more closely spaced.

The 2-drum design may have one, two or three gas passes, left-hand drawing, p 101, depending on the unit's size. Designers take advantage of the extra length of larger boilers and use only one large gas pass, with no convection baffling whatever. The combustion products leave by way of the front, top corner, away from the burner. Except for the few somewhat widely staggered tubes at the gas entrance, the drum-connecting tubes go in on fairly close and equal centers.

Medium-size 2-drum boilers have a 2-pass, U-shaped travel with the gases escaping through the rear, top corner,



WATERTUBE PACKAGE wholely encases boiler proper with insulated steel jacket, suitable for either indoor or outdoor installation; it requires no special foundation

farthest away from the burner. The smaller units are provided with a 3-pass, S-shaped gas path and an exit at the front end, left-hand drawing. p 101.

Both medium-size and smaller boilers have watercooled baffles, and all the tubes in their first pass are placed more widely apart than those of their second or third pass. Then, too, designers reduce the volumetric size of these corridors from the first to the second, or on to the third, to maintain uniform velocity throughout the gas travel in face of the cooling of combustion products.

In either design, single- or 2-drum, the relatively high ratio of furnace-wall cooling to furnace volume offers rapid and efficient heat absorption—hence, lower gas temperatures entering the convection bank.

Water Circulation. Both types have their feedwater entry in the steam drum, and it is here that their oval-shaped water circulation begins and terminates. The single-drum boiler has two such circuits, one on either side of the drum. Fresh water courses down the outer sets of tubes, through the sidewall headers, and back up to the drum bottom by way of the furnace-wall tubes.

The 2-drum boiler also has two separate water circuits. However, one is inside the other. All the incoming water passes down the outer half of the direct drum-connecting tubes. In the mud drum much of the feedwater rises up through the inner-half portion of these tubes, while the remainder travels up through the waterwalls, and so on back to the upper drum.

Front ends of the sidewall headers of the single-drum design prove the coolest sections of this type boiler. Their location in the tail-end of the gas travel, and, too, in the dead-pocket area surrounding the burner's mouth, produces this comparative coolness. These two spots are, therefore, where the greatest sludge accumulation is expected. Surprisingly, though, absence of any sludge build-up here does not indicate a clean boiler, as you might suppose, but serves rather as a sign that scale formation has probably developed elsewhere in the unit. Since these sidewall headers act also as feeders for the highly sensitive waterwalls, it is most vital to avoid excessive sludge pile-up here. Otherwise, fireside tubes then become dangerously fouled. Hence, you need a close control over blowdown.

In the 2-drum design, the relatively large mud drum ordinarily affords

High Ratio of Wall-Cooling to Furnace Volume

ample protection against any appreciable sludge recirculation. Sludge accumulation is more apt to be heaviest in the drum end beneath the gas exit. The rapid water circulation in these boilers, however, makes it good operation to exercise careful blowdown.

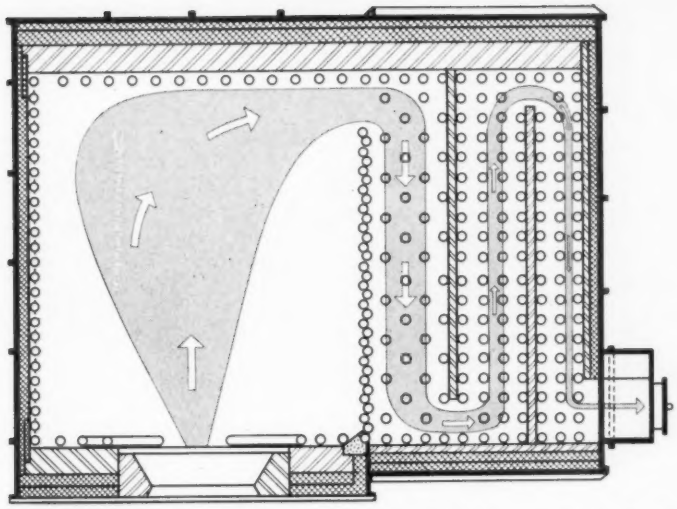
Scale Formation. The waterwall tubes, exposed to the radiant heat of the furnace, constitute the principal heat-absorbing elements of these boilers. As such, they suffer most from the insulating effect scale produces. Because of the greater heat-transfer rate, it takes far less deposit to overheat these tubes than any of the others. Moreover, the higher the pressure, the thinner the scale need be, and the quicker such tubes blister.

The silicate type of scale is denser than the sulfate, which is, in turn, somewhat more so than the carbonate. Their degree of impedance to heat transfer follows this same order. So, at the higher pressures, only a paper-thin silicate scale is enough to bring frequent tube failures in the waterwalls. But in the cooler section of the boiler and at moderate-to-low operating pressures, as much as 1/16 in. of carbonate deposit may be sustained for considerably longer periods. Any form of scale, though, is most undesirable. Once silicate deposits, it proves extremely difficult to remove either mechanically or chemically. The overall heat loss may be only negligible because of later recovery in the convection stages. But the damage and maintenance that scale causes is an entirely different story. They can be quite costly.

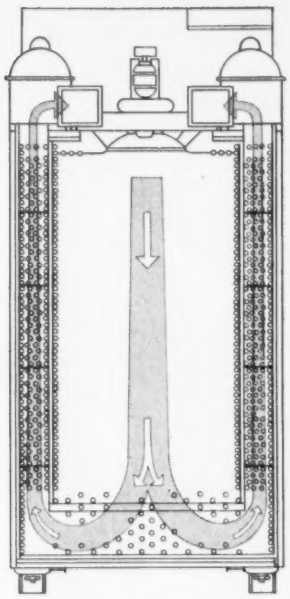
Corrosion. If makeup water is not properly deaerated, you can expect serious corrosion. The relatively cool feedwater, introduced into the steam drum, comes in contact with the hot boiler water at the end of its circulation cycle. Release of dissolved oxygen from the fresh water follows. This corrosive gas may then pit the drum proper along its water-level belt or proceed to corrode the down-comer tubes. Some of this gas escapes with the steam and later joins with carbon dioxide of the condensate to attack the return lines.

Carryover. The large upper drum of a watertube packaged boiler affords adequate steam space and, in addition, room for mechanical steam-purifying facilities as well. Thus, these units are not prone to carryover problems unless pushed to fairly high ratings or made to carry unfavorably high boiler-water solids content.

Embrittlement. The all-welded drum seams of these units greatly minimize any possibility of intercrystalline cracking occurring from local caustic concentration in strained joints. But, as with all boilers, you must (1) avoid developing exceedingly strong caustic alkalinities (2) always watch out for any embrittling tendencies, especially at the rolled-in tube ends. Where any are suspected, run extensive and conclusive tests and take corrective steps.



TWO-DRUM DESIGN, depending on steaming capacity, has one, two or three gas passes like the above. Largest units have only one pass, with no convection baffling



SINGLE-DRUM unit's one gas pass splits at back and returns to front dual exits

Gives Rapid Heat Absorption and Heightens Water-Treatment Needs

External Treatment. Ordinarily with a goodly all-year average of returns and a clear water supply of low-to-moderate hardness, no presoftening need be applied to the makeup water for boilers operating up to 150 psi. From 150 to 250 psi, raw-water hardness would have to be fairly low and volume of recovered condensate consistently high to justify use of internal treatment alone. Above 250 psi, the desired internal boiler conditions can rarely be attained or maintained without the aid of external treatment.

A raw water having both its hardness and alkalinity quite high would be subject to lime-soda softening. A combination of moderately high hardness and fairly low alkalinity renders the sodium zeolite method of softening ideal. In some instances, it may prove sound to (1) couple sodium zeolite with hydrogen zeolite or (2) supplement lime softening alone with sodium zeolite. Still other cases may call for either acid or caustic follow-up to presoftening. In any event, the makeup water's physical and chemical characteristics and the specific feedwater composition for a particular operating pressure dictate what makes the more economical and efficient system. Don't forget, though, with external conditioning, you always need some measure of boiler internal treatment as well.

Corrosion Correction. Feedwater can't be just preheated, for good boiler operation. You must also deaerate it. The thing to do is to expel as much dissolved gas by mechanical means as practicable. Raw water always introduces both oxygen and carbon dioxide gases. And, in addition, as the water's natural bicarbonate alkalinity breaks down, more carbon dioxide builds up in the boiler cycle. Proper deaeration rids the feedwater of practically all of these two gases.

Oxygen, by far the more corrosive, can be completely eliminated with sodium sulfite, which absorbs oxygen to produce the highly soluble and harmless sodium sulfate salt. By constantly carrying a slight excess of sulfite in the boiler water, you insure the absence of oxygen. Volatile organic amines fed into boiler water neutralize carbon dioxide gas in the steam. But you can't recover these chemicals, and so justifying their relatively high cost is always a difficulty.

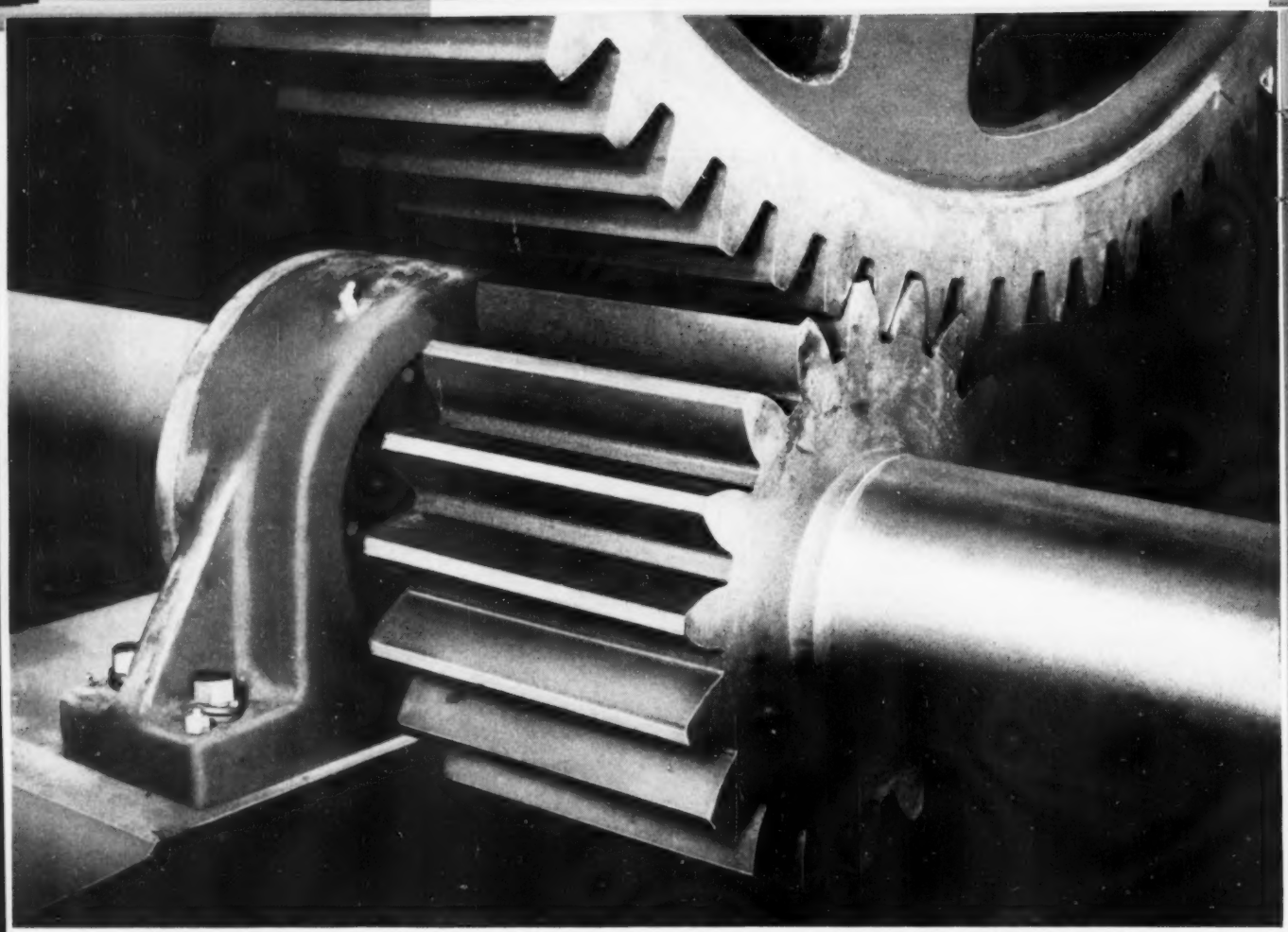
If you use a steel economizer, inject a little caustic soda. While caustic soda is somewhat hazardous to handle and difficult to regulate, it is non-gas-producing and serves to restrain carbon dioxide action, which would otherwise develop at this elevated temperature. Controlled recirculation of a small portion of boiler water also gives a similar effect.

Calcium Correction. As previously recommended for firetube-type packaged boilers (POWER, June, p 76), the phosphate-organic treatment has thus far proven the more effective of boiler internal corrective methods. It precipitates the boiler water's concentrating calcium hardness in the form of tricalcium phosphate. This product readily falls out as a fine non-scaling powder. By consistently maintaining a slight residual of phosphate you are assured of a steady zero-hardness boiler water. Since both the phosphate and calcium can remain unreactive with each other below a pH of 10, be certain to furnish enough alkalinity to the boiler water to drive this reaction to completion. Precalculated proportioning of the various forms of phosphates will give the desired alkalinity range under any given operating conditions. An appropriate organic coagulant added at the same time combats the packing and sticking tendencies of tricalcium phosphate. If this deposit is kept fluid, blowdown removes it easily.

Magnesium Correction. Magnesium, generally the minor partner of the calcium, magnesium hardness-contributing constituents, can, however, prove quite troublesome, especially if you let it come down in the phosphate form. To avoid producing this very sticky and uncoagulative deposit, you'll have to carry fairly high boiler-water alkalinities. By so doing, you insure, instead, the precipitation of the gelatinous, and even helpful, magnesium hydroxide.

Silica Retention. As silica undergoes concentration in the boiler water, it acquires a growing tendency to drop out of the solution, preferably in union

(Continued on page 216)



SOUND GEAR DESIGN, proper application and smart lubrication know-how are three essential ingredients for long gear life

Today's Thinking on Gear Failures

. . . points up the important fact that most troubles you meet are not the fault of the lubricant. Here are eight factors, including design and operating practices, that come into the picture

Tooth Spacing

When teeth of a high-speed gear are not accurately spaced their surfaces are subjected to dynamic loads that limit the useful power the teeth can transmit. For example, consider a high-speed gear train having high moments of inertia for both prime mover and load. If there are sizable errors in tooth spacing, instantaneous changes in angular velocity result. And when we consider teeth that are in contact for only one ten-thousandth of a second, the blow transmitted from one tooth to another pierces the oil film and damages both.

Many gear-design specifications indicate that as speed increases, useful power that may be transmitted decreases. Where such specifications are used, the theoretical power that the gears can carry is calculated, then derated by a "velocity factor" to determine the actual power. But where teeth are accurately spaced, recent tests prove velocity factors are unnecessary. As speed increases, the load carried can also be increased. Consider teeth accurately spaced where tooth-to-tooth error does not exceed 0.0002 in.

Tooth-Surface Finish

If surface finish is rough, teeth may be likened to two files in contact (POWER, Dec 1951, p 80). Hills on the tooth face may pierce the lube film allowing the two mating surfaces contact. But if lube viscosity is high and load light, teeth

will ride on the lube without metal-to-metal contact. As load increases a point is reached where the hills of mating surfaces make contact, or hills on one surface fall into valleys opposite. Mechanical shearing of metal or bending of hills results in heat. This has been proven time and again.

Many engineers think that if tooth surface is too highly refined, surfaces will not sustain a lube-oil film. This belief needs qualification since speed enters the picture. It is possible that a hydrodynamic film will not be established with highly polished tooth surfaces and extremely low sliding velocity. But where sliding velocity is high, say 30,000 to 50,000 fpm, a fine surface finish is desirable. A hydrodynamic film is established and the teeth are satisfactorily lubricated. So under high velocities, have tooth-surface finish fine.

It has also been said that if surface finish is absolutely perfect (ideal case) no lubricant is required. This is true if load is kept at extremely low values. But as load is increased surfaces deflect. Plastic working of surfaces generates heat, which must be carried away by a lubricant.

Tooth Modification

Gear teeth may check out as perfectly spaced with instruments and yet run into trouble during operation. Consider two perfectly spaced gears in mesh giving a smooth engagement at no load. As load increases, teeth sharing load begin to deflect. This, in effect, displaces teeth somewhat. What may actually happen is that the corner of a tooth strikes its mating tooth, scraping off the oil film. Tooth modification prevents this, increasing by a certain amount both the radius of curvature and the depth. The effect is that of the upturned ends of a pair of water ski when pulled through water at high speed. This modification has worked well for gears that ran into trouble at high speeds and heavy loads.

Sliding Velocity; Pitting

Engaged teeth slide between both surfaces except for the instant when rolling takes place at pitch line. Maximum sliding velocity is a function of tooth proportions. If extremely long addendum teeth are used, sliding velocity at tip of tooth is high. And unless teeth are modified and surface finish highly refined, their tips may burn. So length of teeth and sliding velocity should be considered wherever tip burning is met.

Since pitting may occur on teeth carrying a normal load, we can assume slight imperfections give in localized points of high pressure.

In general, if speed and load are held constant, pitting ceases with time. Areas between pits become polished and no further pitting results.

Abrasive Wear

Foreign material in lube oil generally causes abrasive wear. The tooth appears to have been rubbed with emery cloth or sandpaper. Abraded surfaces show scratches at right angles to the tooth axis.

Scoring generally results from small particles becoming welded to the mating elements, producing scratches that extend radially along tooth flank. They could also be caused by a high point becoming so warm it adhered to mating element. A scratch is produced since high point is trapped between two loaded surfaces moving in opposite directions.

Burning, Rolling

As mentioned above under sliding velocity, burning can take place in meshing gears. It results in discoloration of tooth surfaces indicating: (1) Lube oil did not carry away heat generated between two surfaces. (2) Load was too high. (3) Coefficient of friction between surfaces was excessive.

Some teeth under load form a little burr along tip, which indicates metal is being displaced from surface. Where teeth are not discolored any heat formed is being carried away. Rolling appears to stem from a plastic flow of material and has been observed on moderately loaded teeth.

Analyzing the Fault

Pitting, abrasive wear, scoring and burning on the surface might be considered as lubrication failures. Since pitting points to localized stress concentration, it is highly improbable that a lubricant could be applied that would prevent it. Assume tooth-surface load is distributed across the face giving a stress of 90,000 psi. But if a number of bumps are present equal to 10% of total tooth area, unit pressure becomes 900,000 psi, resulting in pitting.

If enough lubricant is present to keep temperature of high points below temperature at which they adhere to mating members, particles pitted out go into lube oil and are picked up by a magnetic strainer. But if temperature increases to point of seizing, material adheres to mating member and score marks are produced on mating-tooth surface. When you note signs of abrasion, clean lube system and filter oil.

Typical Gear Failures

Following are four cases of gear failure, a logical analysis and remedy:

1. Marine gear becomes noisy and indicates wear through metal particles picked up in magnetic strainer. Close check shows a nut or bolt has gone through the mesh. Teeth had been corrected by filing. But because of filing, tooth surfaces have been roughened and wear started. Small steel particles given off from this wear contaminate the oil and induce wear in other parts of tooth surfaces.

System should be flushed and oil filtered. It may be best to put in a heavier oil till teeth have again obtained a polish.

2. Marine gear has operated for 10 years but during last year has started showing undercutting and metal particles in lube oil. Careful examination will probably show up dirty oil. If condition is noted early enough and corrected, gears will often polish up. If wear has progressed, it may be best to use a heavier oil till teeth again take on a polish.

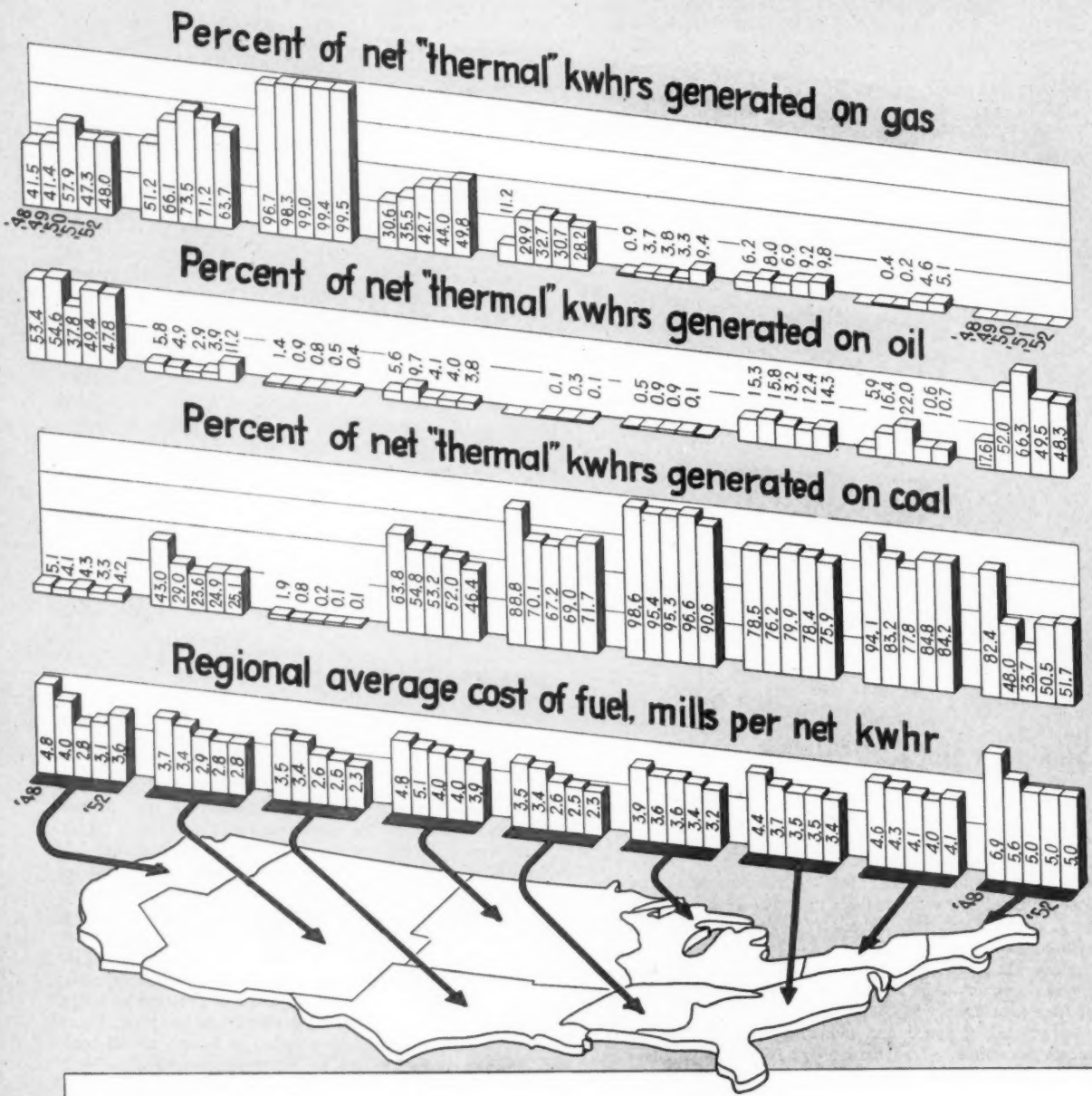
3. Heavily loaded new gear starts pitting after operating one week. Pitting on a new gear points to presence of slight bumps on tooth surface causing stress concentration. Since gear is heavily loaded, best solution is to use an oil with anti-welding properties or an extreme-pressure oil. Teeth should then polish up with time.

4. Gear unit driving an induced-draft fan becomes noisy yet tooth surfaces appear OK. You will probably find that while the pinion teeth look good they have worn unevenly. Their pitch line is no longer concentric with axis of rotation. Further examination may show load is far from constant and torque varies. The oil is contaminated with flyash, and cyclic wear has taken place.

Solution: Recut gear, pinion; clean system; if possible, eliminate load variation, or at least reduce its magnitude.

Many cases have been found where a tooth has broken out under heavy loads and the lubricant has proven "stronger" than the tooth. Study showed the tooth surface highly polished, free from pits, abrasion, rolling or galling.

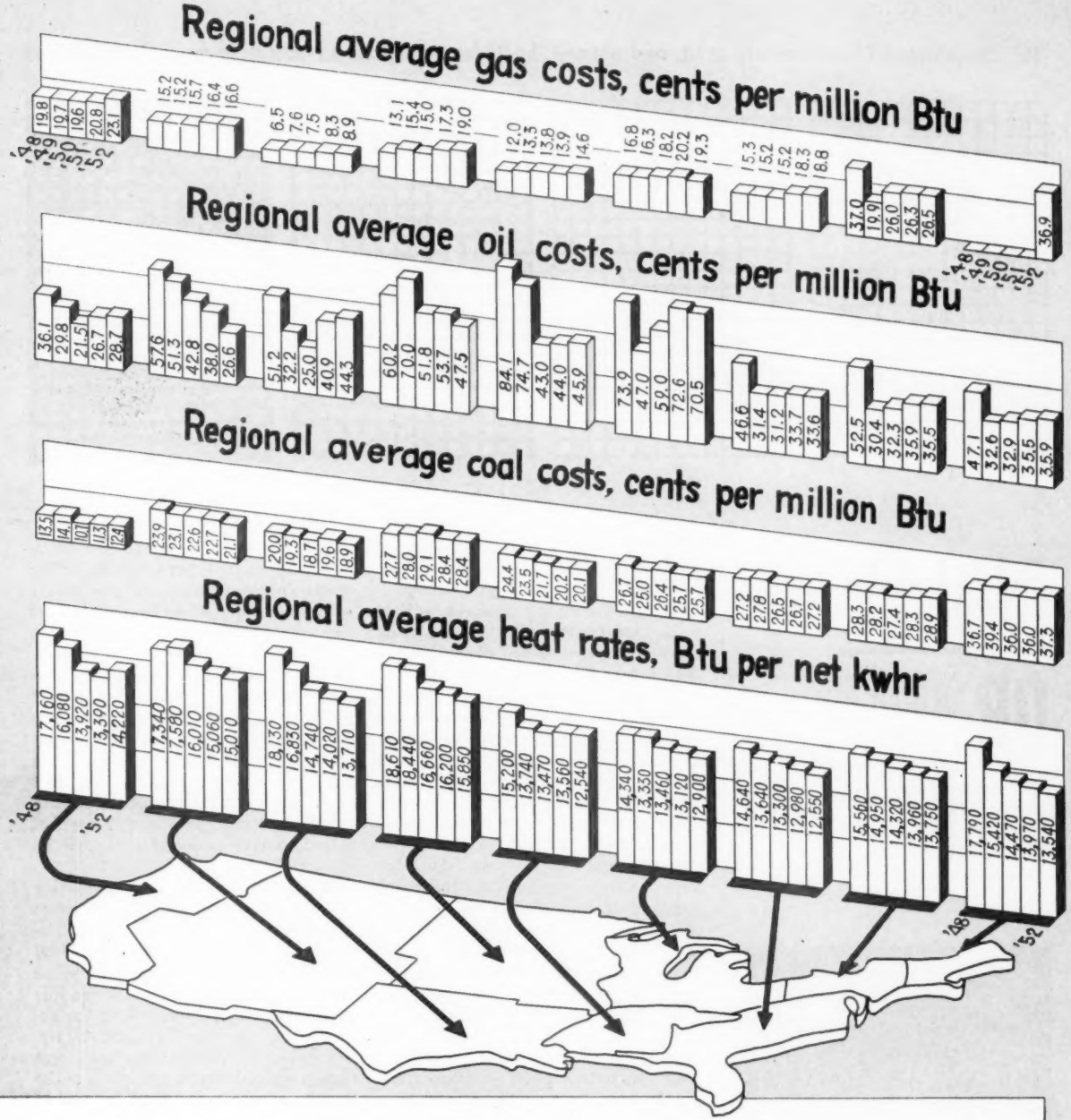
EDITOR'S NOTE: This article is a free adaptation from the paper, *Lubrication Requirements of Gears as Seen by a Gear Engineer*, by L J Collins, General Electric Co, presented at ASLE annual meeting, Boston, April 13, 1953.



Utility Performance Shows Improvement

► DATA ON average central-station heat rates, fuel costs and fuel utilization for the years 1948 to 1952 were recently released by the Edison Electric Institute. The national averages are shown in the table on the facing page. Similar data for the nine U.S. regions appear in the two sets of dimetric graphs above.

Groups of bars from left to right refer to: *Pacific states* including Wash., Oregon, Calif.; *Mountain states* including Nev., Utah, Ariz., N. M., Colo., Wyo., Idaho, Mont.; *West South Cen-*

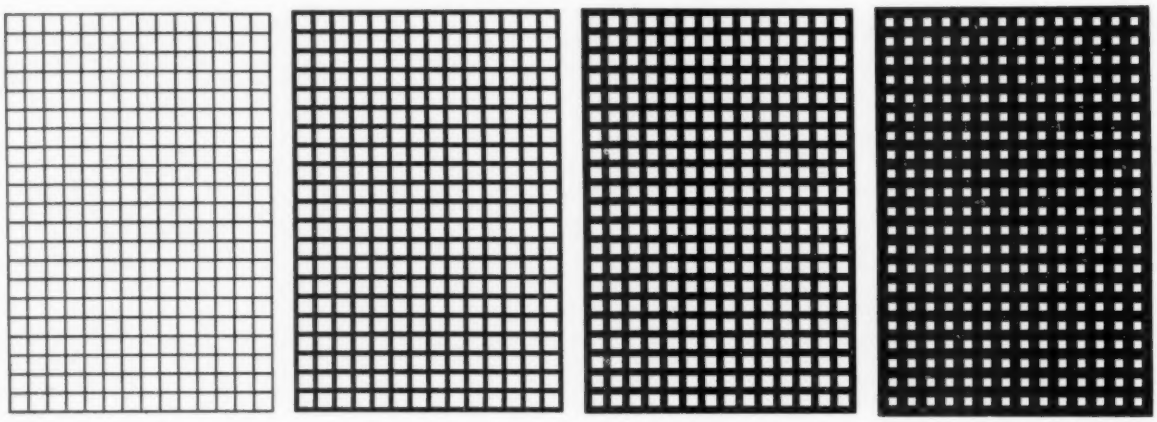

Regional average gas costs, cents per million Btu
Regional average oil costs, cents per million Btu
Regional average coal costs, cents per million Btu
Regional average heat rates, Btu per net kwhr
'48
'52

tral including Ark., La., Okla., Tex.; *West North Central* including Minn., Iowa, Mo., N. D., S. D., Neb., Kan.; *East South Central* including Ky., Tenn., Ala., Miss.; *East North Central* including Ohio, Ind., Ill., Mich., Wis.; *South Atlantic* including Del., Md., D. C., Va., W. Va., N. C., S. C., Ga., Fla.; *Middle Atlantic* including N. Y., N. J., Pa.; *New England* including Me., N. H., Vt., Mass., R. I., Conn. "Thermal" kwhr refers to output of steam and internal-combustion engine stations.

Average Performance, Fuel Costs, Fuel Utilization Of the Electric Utility Industry

Year	Heat rate, Btu per net kwhr	Fuel cost, mills per net kwhr	Fuel cost, ¢ per 10^6 Btu				Percent of net "thermal" kwhr generated on:			Thermal kwhr, % of all kwhr
			Coal	Oil	Gas	Avg	Coal	Oil	Gas	
1948	15,738	4.2	27.9	45.3	10.5	26.7	75.7	8.4	15.9	70.8
1949	15,033	3.8	27.1	34.2	11.8	25.2	67.6	13.5	18.9	69.2
1950	14,030	3.5	26.9	31.8	12.3	24.8	67.6	13.4	19.0	70.9
1951	13,641	3.4	26.8	33.6	14.1	24.9	69.4	9.8	20.8	73.1
1952	13,366	3.3	27.1	33.8	15.3	25.0	68.2	9.6	22.2	73.7

The Ringelmann Chart—widely used, and abused, basis for municipal air-pollution control ordinances



GUILTY OR NOT?

► MUNICIPAL SMOKE INSPECTORS are finding this an increasingly tough question to answer when it comes to proving, to the satisfaction of the courts, their cases against violators of anti-smoke ordinances. A key to the problem seems to be the Ringelmann Chart, a 70-year-old yardstick for smoke measurement published by the United States Bureau of Mines. Below we have two incidents in which courts have dismissed anti-smoke charges for lack of evidence based on the proper use of the Ringelmann Chart.

In a recent Chicago case, the Municipal Court convicted an industrial company of having violated the city's anti-smoke ordinance. This conviction was based on the testimony of a city smoke inspector who stated that, on two occasions, there was an emission of smoke of greater density than permitted under local ordinances based on the Ringelmann Chart.

The Appellate Court of Illinois set this decision aside on the ground that the following facts discredited the inspector's testimony: (1) defendant company had installed an electronic smoke indicator in the stack in question, and an experienced engineer had proved the device to be accurate, (2) the indicator recorded the density of the smoke on graphs on the days in question and these graphs did not show emissions of density greater than permitted by ordinance specifications.

The inspector testified that he determined the smoke to be excessively dense by referring to the Chart, but he did not state how long he'd been an inspector nor his experience in that line. Nor did he state whether he'd followed the standard Chart instructions.

The Appellate Court concluded: "The smoke abatement ordinance is necessary in a community like Chicago, and its enforcement is important. When, however, the defendant in good faith employs the most scientific means recommended by the city for detecting density of smoke to avoid violation of the ordinance, and the graphs do not show any record of No. 3 density for the days in question, it cannot then be said that plaintiff sustained the burden of proving defendant's guilt by the testimony of the one smoke inspector as to the alleged violation."

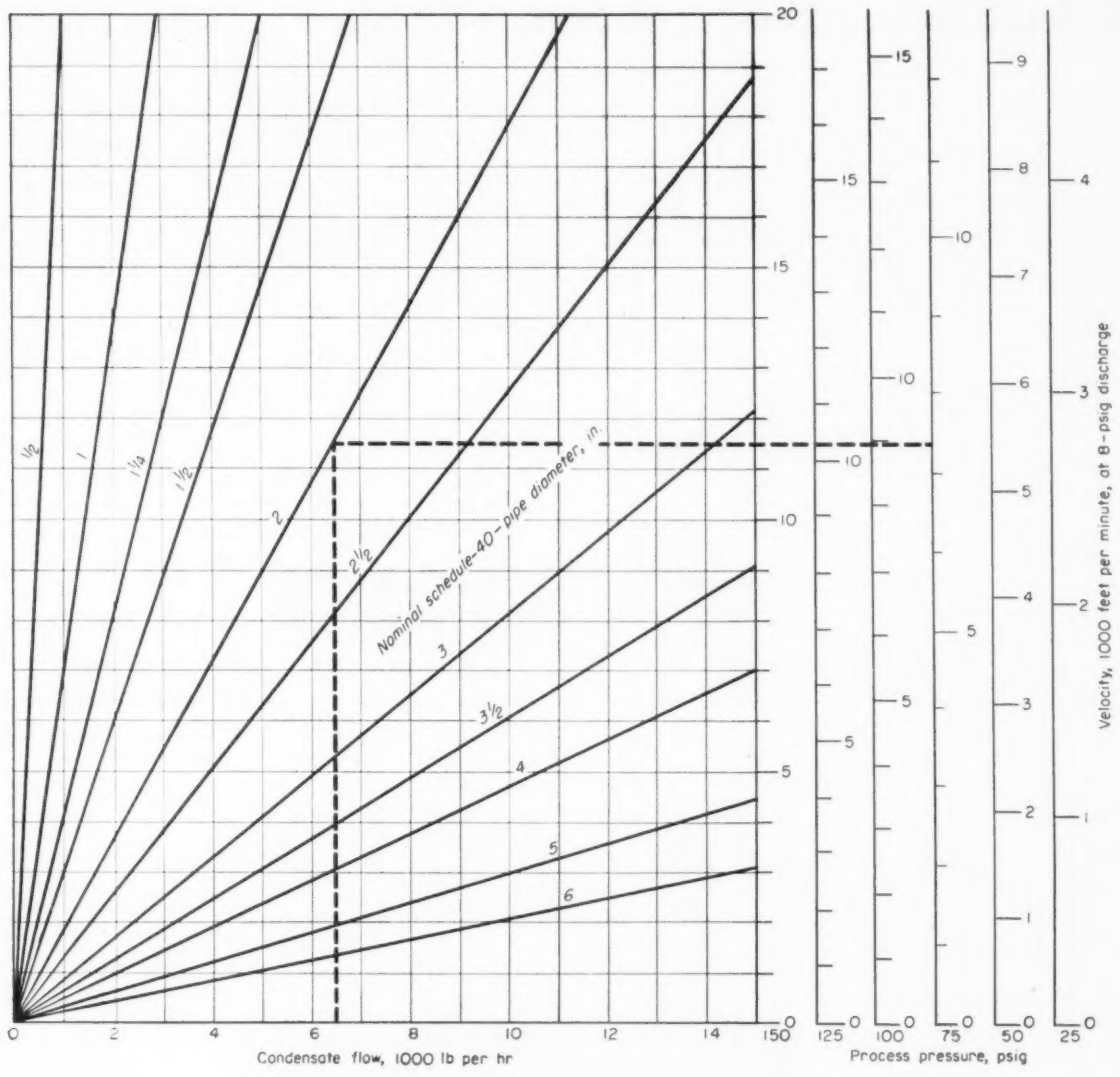
St Louis inspectors, too, are having their troubles in trying to pin down violators of city smoke ordinances. Recent charges brought against a local laundry were dismissed by a police judge. In this case, three inspectors gathered evidence by observing the defendant's stacks from May through July. Despite these efforts, the case was thrown out of court on grounds that the Ringelmann Chart had not been used in gathering evidence.

And so the dilemma continues. In spite of its admitted inadequacies, the Ringelmann Chart is used to define smoke-density limits in many ordinances because it is the only relatively simple measuring method. Quite properly in such cases, the courts refuse convictions unless the Chart is used and used correctly. But because of the inconvenience of viewing the Chart at 50 feet, inspectors often neglect to use it—or don't follow instructions to the letter.

POWER feels there are ways out of this dilemma. Watch future issues for a review of specifications defining the Ringelmann Chart and suggestions for making its principles easier to apply.

Power's DATA SHEET

No. 258



Condensate Velocity Fixes Pipe Size

► To avoid too great a pressure drop in trap discharge lines carrying a mixture of condensate and flash steam, the pipe must be large enough to keep velocity low. It is customary to allow maximum velocities of 1000 fpm per inch of inside pipe diameter for dry steam. To minimize erosion with flash steam carrying a high proportion of water, the velocity should be lower than this. The above chart may be used for process pressures ranging from 25 to 150 psig, discharging to an exhaust pressure of 8 psig through a Schedule-40 pipe.

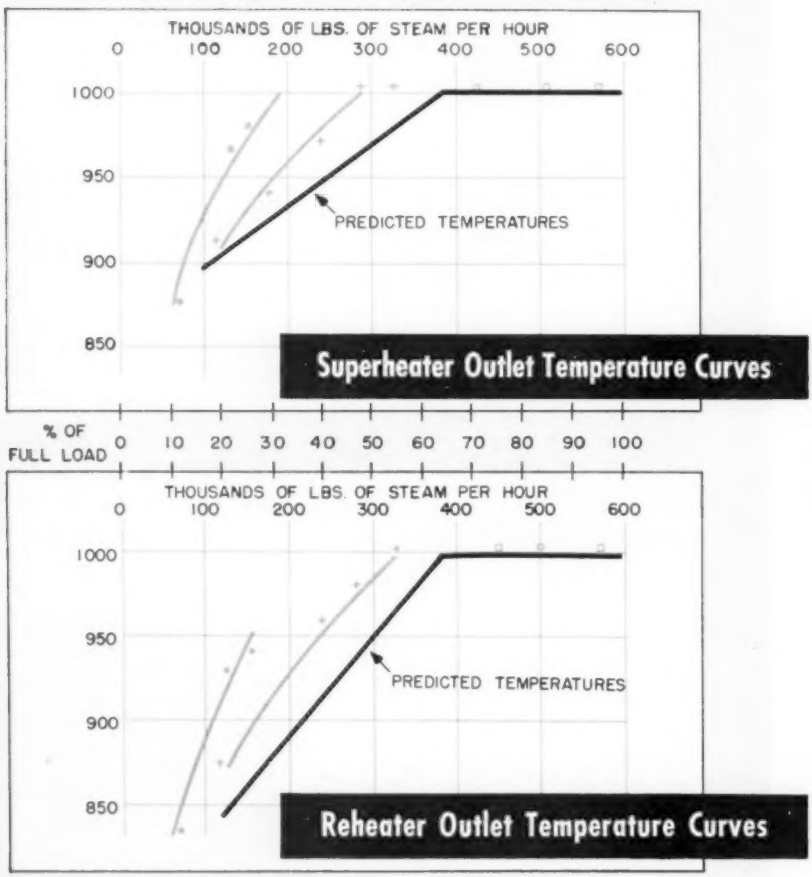
Example: A process kettle discharges 6470 lb per hr of condensate at 75 psig through a trap to an 8-psig exhaust line. What will the velocity be? Find the flow of 6470 lb per hr on the lower left scale and follow trace vertically to intersect with the 2-in.-pipe curve. Follow trace to right to read velocity of 7400 fpm on the 75-psig scale. This indicates that pipeline is too small since velocity should be less than 2×1000 or 2000 fpm. Three-inch line gives velocity of 3300 fpm. Still too high. So use 3½-in. pipe. If larger pipe size can't be used, a pump or condensate cooler must be installed to maintain discharge-line capacity, or flow will be reduced.

Suggested by K M Holaday *Webster Groves, Mo.*

© POWER

RILEY Reheat Unit at Maintains Constant Reheat

down to less



plus

Over-all performance better than guaranteed with air heater exit temperatures and draft losses lower than predicted.

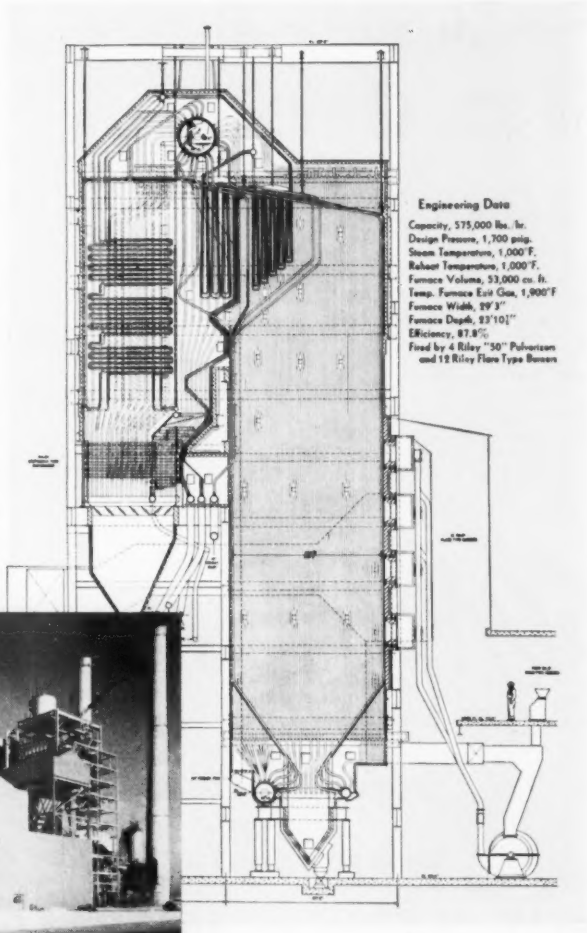
A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power cost

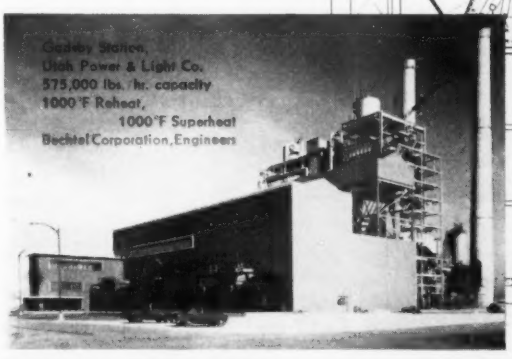
Utah Power and Light Company and Superheat Temperatures *than 50% load!*

The modern Riley Reheat steam generating unit at the Gadsby Station, Utah Power and Light Company, has continued to give entirely satisfactory service without a single major alteration or adjustment since it went on the line in November 1952.

The unit is designed for a nominal turbine flow of 575,000 pounds of steam per hour and uniform total reheat and superheat temperatures of 1000°F each, with loads down to 400,000 lbs. hr. To accomplish this, primary elements of the reheater are exposed to the furnace and absorb heat by radiation. The practicability of this design has been borne out in performance with *constant temperatures down to less than half load.*

In addition, over-all performance was better than guaranteed with air heater exit temperatures and draft losses lower than predicted. Here is another good example of the advantages to be gained from doing business with Riley. Time after time Riley units have produced performance bonuses such as this. You, too, can possibly realize large savings in power costs by installing Riley steam generating units.


Engineering Data
Capacity, 575,000 lbs. hr.
Design Pressure, 1,700 psig.
Steam Temperature, 1,000°F.
Reheat Temperature, 1,000°F.
Furnace Volume, 53,000 cu. ft.
Temp. Furnace Exit Gas, 1,900°F
Furnace Width, 29'3"
Furnace Depth, 23'10½"
Efficiency, 87.9%
Fired by 4 Riley "50" Pulverizers and 12 Riley Flare Type Burners



These Public Utilities Have Ordered Riley Reheat Units

Houston Lighting & Power Co.
1,250,000 lbs. hr. 1005°F Reheat

Texas Electric Service Co.
1,250,000 lbs. hr. 1005°F Reheat

Public Service Co. of Indiana, Inc.
884,000 lbs. hr. 1005°F Reheat

Dept. of Water & Power
City of Los Angeles
1,200,000 lbs. hr. 1000°F Reheat

Louisiana Power & Light Company
1,000,000 lbs. hr. 1005°F Reheat

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RILEY
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COMPLETE STEAM GENERATING UNITS

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WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.

SONDERGLASS

THE *SAFE* GAUGE GLASS

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NEW PRESSURIZED SPRAGRIP

First Effective Treatment for V Belts

Spragrip is an entirely new development and unlike any other belt dressing you have ever used. It is a permanent type dressing that gives an immediate power boost and will not lose its grip due to aging, oxidizing, glazing or drying out on the belt. Treat your V, flat, round, leather, rubber or fabric belts the easy way. Just press the button on the modern pressurized can of Spragrip and safely spray hard-to-reach sheaves and belts with this power boosting formula. The same formula is packaged in spout applicator cans under the trade name Belt-Flo. Money back guarantee. Write the A. W. Chesterton Co., Everett 49, Mass. for full information.

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Western Ind. Sup., Sacr.
Mission Pipe & Sup., San Diego
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Savannah Ship Chand., Savannah
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Indianapolis Belt & Sup., Indianapolis
Industrial Sup., Terre Haute

Illinois
Grt. Westn. Sup., Chicago

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Louisiana
Peerless Sup., Shrvpt.
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Standard Sup. & Hdw., New Orleans

Massachusetts
Fred C. McClean Sup., Springfield
Fall River Steam., F. R.

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Natl. Eng. Co., Baltimore

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Kenneth Anderson, Det.
I. W. Swift Co., Houghtn.

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Goodin Co., Minn.

Mississippi
Gen. Sup. & Mch., Meridan

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Rubber Prod. Co., St. Louis

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Interstate Mchy., Omaha

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Somers, Fitler & Todd, Pittsburgh
Reading Fdy. & Mch., Reading
Chas. B. Scott, Scranton
H. P. Weller Sup., Erie
Eastern Penn. Sup., Wilkes-Barre

Rhode Island
R. I. Sup., Providence

South Carolina
Sumter Mchy., Sumter
Allen & Webb, Charleston
Poe Hdw. & Sup., Grnvle.
Columbia Sup., Columbia

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Schieren-Jarvis, Salt Lake

Virginia
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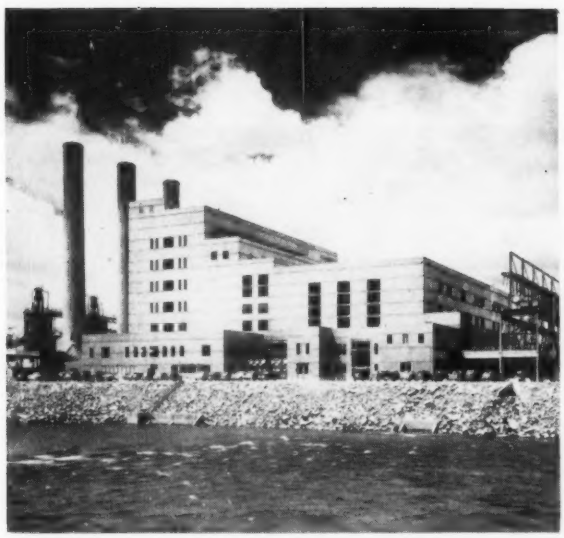
AMERICA'S OLDEST MANUFACTURER OF MECHANICAL PACKINGS



KILOWATTS and calories team up inside this aluminum-clad building for efficient power generation, happy employes

Modern Homelike Plant...

Goes all out for employe conveniences

By **STEVE ELONKA**, *Associate Editor*

- ***Electric kitchen feeds men during emergencies***
- ***Latest equipment makes repairs easy***
- ***Sparkling plant is efficient, keeps men happy***
- ***Locker rooms, showers are tiled and spotless***
- ***Training manual acquaints each man with job***

► WHEN SUPERINTENDENT of Production John Miller and Superintendent John Witman showed me around their new Titus plant in Reading, Pa., recently, I was greatly impressed. What really opened my eyes, though, was their modern kitchen. But before I go into that, suppose I tell you about their generating capacity and major equipment.

Building. Latest in Metropolitan Edison Co's chain, this plant features modern facilities for convenience of operating personnel. Building is aluminum-clad and has turbine and boiler rooms, service and office sections.

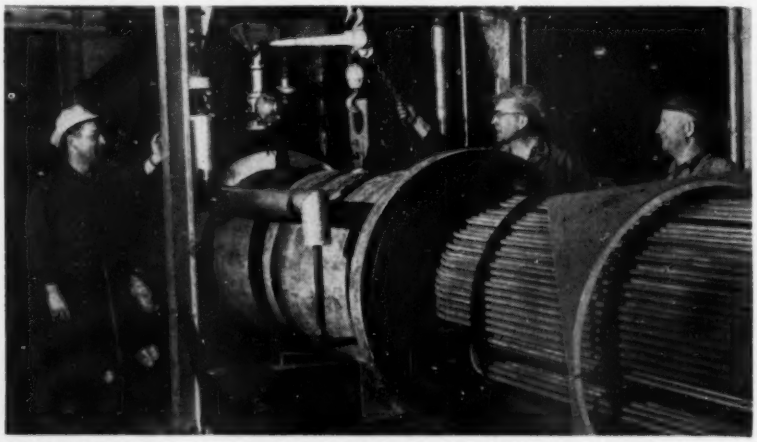
Three units produce 240,000 kw. Each generator is 80,000 kw maximum under 15-psi hydrogen cooling. They deliver 3-phase 60-cycle alternating current at 13,800 volts.

Turn page

WASHROOM is clean and airy with plenty of room. Cleanliness here encourages clean work habits around the plant machinery

TWO LOCKERS, one for work clothes, the other for dress, enable mechanics to wear best dress clothes to and from the plant

ONE TRIP takes all chain hoists to work and brings them back in good shape



REMOVING heater shell from tube bundle is easy with this portable steel frame. No damage to ceiling, piping or other equipment from chain hoists or from rigging

This Pleasant Place to Work Encourages Good, Safe...

Boilers are reheat type, pressure is 1475 psi at 1010 F. About 30 carloads of bituminous coal are burned daily. Rotary car-dumper unloads one car in five minutes. Coal mills, in basement, dry coal with exhaust gas and grind it to talcum-powder fineness. Mechanical dust collectors remove most of the flyash produced.

Kitchen. What impressed me about this plant was the homelike surroundings for operating personnel. When an overtime repair job comes up, for example, men wash and go into a pleasant dining room. In the meantime, one of them has prepared a hot balanced meal although he may not know anything about cooking. How? Frozen dinners are the answer.

Kitchen has a 10-cubic-foot refrigerator, packed with frozen dinners. There is a choice of Swiss steak, pot roast, haddock or beef stew. Mechanic puts on asbestos gloves, removes from refrigerator the dinners that men ask for and places them on trays, then in an electric oven. In a few minutes meals are ready. Drawers are filled with plastic spoons, knives and forks. Electric heater gives instant hot water. Tea bags or instant coffee placed in a paper cup of hot water does the rest. There are also paper containers of milk.

When the meal is finished, men dump contents of their trays in a garbage can. There is nothing to wash or clean up because plates and cups are throwaways. Boy, what a housewife would give for this setup!

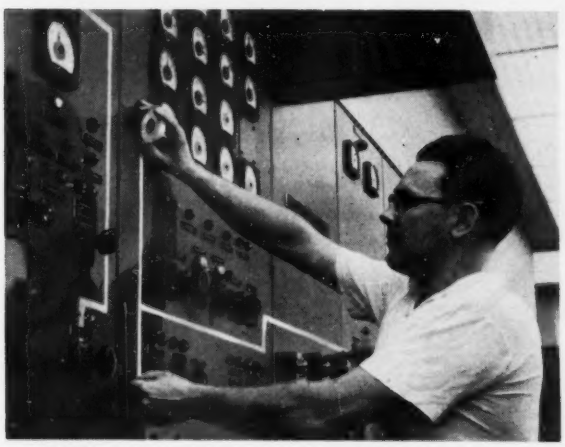
Locker Rooms. Sparkling locker and washrooms are another eye opener. Each man has two lockers, one for his work outfit, another for clean clothes. There is plenty of space in these rooms for all. Showers and washrooms have everything any man would expect in his own home—and more.

Manuals. To make sure each man knows his job, he is given a 300-page operation and maintenance manual, prepared for this plant. Flow diagrams, sketches and data break down the complex systems and equipment for easy studying. Manuals are enthusiastically received. Loose leaves are added, or removed, as time goes on and changes are made.

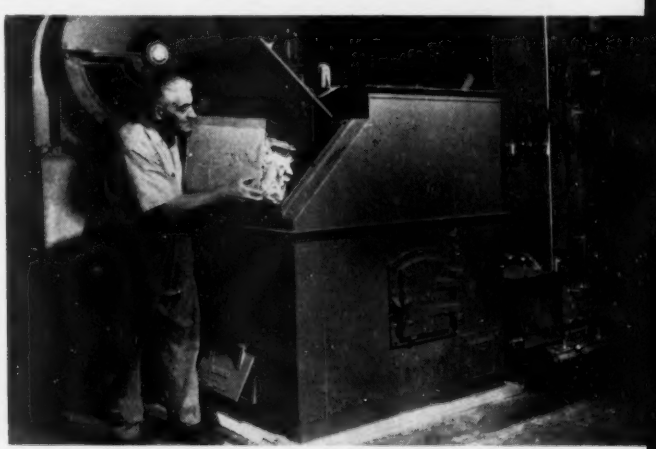
Tools. John Miller told me they went to extra expense in cutting down on manual work. For example, they have

MANUAL on operation and maintenance prepared for this plant is given to each employe so he knows his job, feels at home

PORTABLE workbench has spotlight, vise and grinding wheel, is well-stocked with tools, saves many man-hours on the job



COLORED adhesive tape on control panels forms schematic diagrams of various systems. Each system has a different color



INCINERATOR burns trash before it has a chance to spread around. Trash is always a problem in a pulverized-coal plant

...Work Habits, Holds Responsible Men for a Long Time

a portable tool bench that has proved very useful, as have many power tools and precision instruments. Tool bench has drawers of tools, electric spotlight, vise and grinder. It's quickly wheeled to repair job with needed tools, extension cord plugged into nearest outlet and ready for action. No running back and forth to tool room every few minutes. It pays for itself in the time saved.

Practical Aids. When chain hoists are needed, a special floor truck with eight hoists is pushed to the job. Because hoists are kept on this truck when not in use, there is no extra handling.

For routine maintenance jobs that come up periodically, special practical aids are built. One is a portable steel frame made of channel iron for suspending a feedwater heater shell when removed for coil repair. This not only saves work, but piping or overhead isn't damaged with suspended rigging.

Photo of this rig tells a second story. Large spiral-wound gasket shown is supported inside a sheet of stiff cardboard. First gasket is placed on cardboard and sharp knife guided around outside while cutting. Then gasket is placed inside opening in cardboard and tied with thin string in four places. Cardboard holds gasket in perfect circle, which prevents damage and helps position it when closing heater. This method is good for placing gaskets in many tight places.

In the large control room I ran into another neat trick. Plastic tape in various colors makes schematic diagrams on control panels. That helps operators identify lines and circuits at a glance. New operators also learn systems quickly.

Clean Plant. Trash removal is always a problem where only powdered coal is burned. Incinerator recently installed at this plant has solved that headache. Trash is burned before it becomes a nuisance.

First impression when entering Titus plant is that this well-organized place moves like clockwork. Everything has a place and every place is orderly. People are pleasant and seem to be enjoying life while doing their work. Like many other plants I've visited, this one is not merely a place to work, it is also a way of life—an American way of life. And employe conveniences have played a large part in making it so.

OPERATORS' NOTEBOOK 70

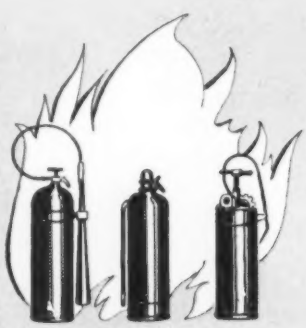
Know How to Use the

Five Handy Fire Fighters

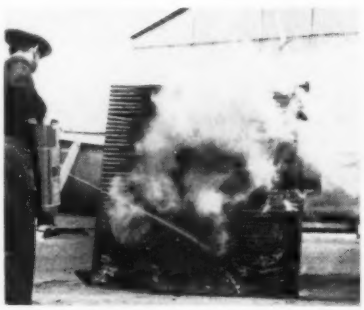
TYPE OF FIRE

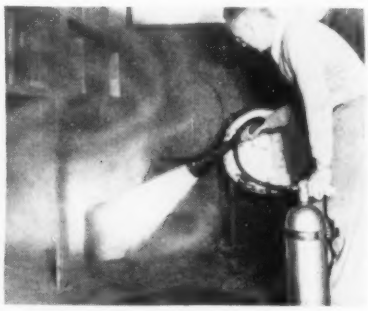
CLASS A: Fires of wood, paper, cloth, rubbish, etc. Use pump tank, soda acid or just water

CLASS B: Fires of oil, gasoline, grease, paint, etc. Use CO_2, dry-chemical or foam type

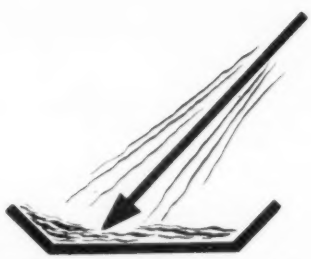


CLASS C: Electrical-equipment fires. Put out with CO_2, dry chemical or vaporizing liquid





SODA ACID OR WATER. Use on class A fires only. Start at top of wall and work down, wetting surface as you go to knock down flame. Then go back and drench thoroughly to prevent reflash. Range of stream is from 30 to 50 feet



CARBON DIOXIDE (CO_2) is for class B and C fires. Direct the gas across the flaming area and sweep the fire before you. CO_2 is a nonconductor, leaves no residue, and does not affect equipment or even foodstuffs. Range is 3 to 6 feet

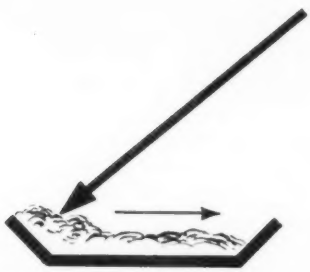
How to Operate

SODA ACID OR WATER. Turn upside down, bump on ground to create pressure. Main extinguishing agent is water, so keep away from the electrical equipment

CARBON DIOXIDE (CO_2). Unhook hose, pull out lock pin, squeeze trigger or turn handwheel. Discharge at fire base. Keep the stream range at about 3 to 6 feet

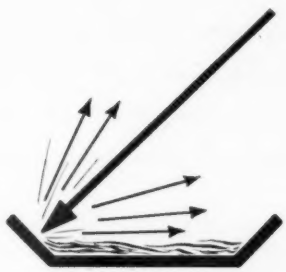
Right Fire Extinguisher

By **STEVE ELONKA**, *Associate Editor*



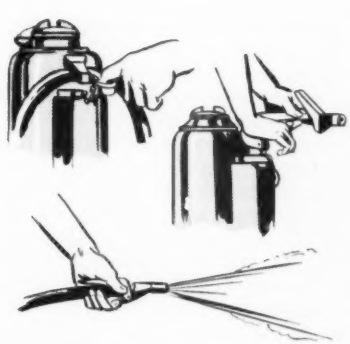
FOAM. Use n class B, alsoo on class A fires. Back the stream of foam off the opposite side of the wall (if possible) to build up a solid blanket of foam without splashing the burning liquid and without spreading it. Range is 30 to 40 feet

DRY CHEMICAL. For class B and C fires. Direct stream into nearest corner of fire (if possible) and sweep across flame. Chemical releases a smothering gas on fire; fog of dry chemical shields operator from the heat. Range is 8 to 12 feet



VAPORIZING LIQUID. For class B and C fires. Play stream against side of container or wall to break it into droplets so liquid vaporizes quickly. Remember, it's the vaporized gas and not the liquid that puts out fire so gas must contact fire

FOAM. Turn over, bump on the ground. Aim at base of wood fire, float foam on top. The foam is a flowing blanket of durable bubbles filled with an inert gas



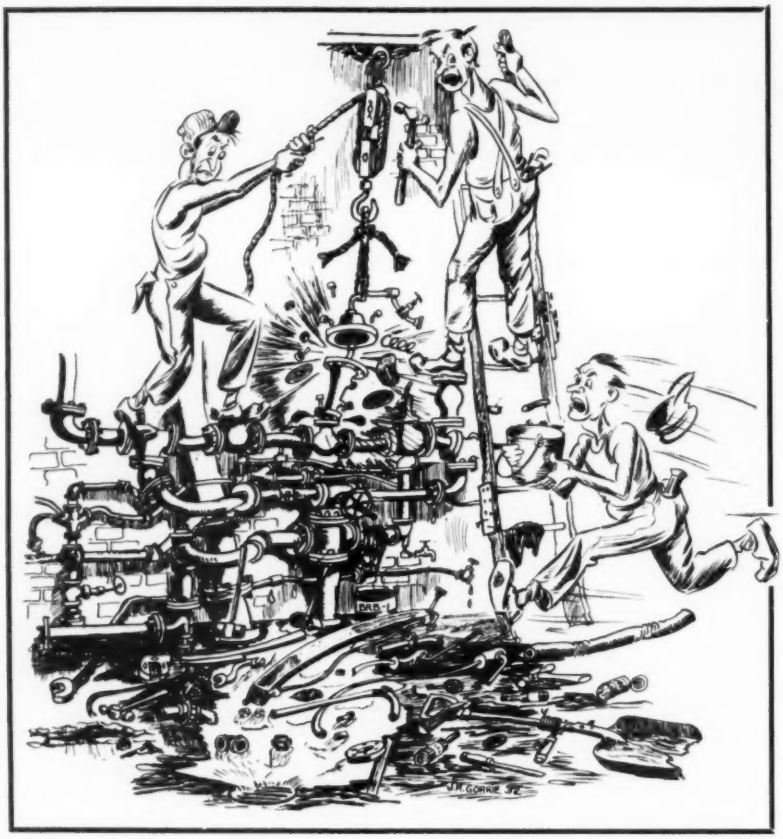
DRY CHEMICAL. Remove ring pin, free hose, push lever down, squeeze nozzle-handle—or, if another make, unhook hose, pull lock pin and squeeze trigger

VAPORIZING LIQUID. Unlock by turning handle. Pump stream on burning material. Range of stream is 20 to 30 ft. V-L is nonconductor, won't damage equipment

STEAM

Don't Murder Your Feed Regulator

'All automatic feedwater regulators are good,' says John Gorrie, ex-insurance inspector, 'but you cannot expect them to work if they are abused'



"HEAVE AWAY," yelled Gus, so Butch heaved, and up came the piston plunger out of its bed of soda ash, lime and corruption. Buster caught the pieces in a bucket

► MANY SERIOUS BOILER FAILURES causing loss of life and property can be prevented if operators understand the boiler feedwater regulator. Safety engineers and boiler inspectors often overlook this device. Or they neglect to find out if feedwater regulator is operating properly. They often take it for granted that the safety valves and water columns are the all-important items to try out.

Faulty Installation. Efficiency of the boiler feedwater regulators depends on right installation, and the maintenance of component parts. Don't assume that this device will work well regardless of how it's set up. Often it only gets attention when it fails. Then hammers, pipe wrenches and wrecking bars are used. So the "damn thing" gets murdered, and everybody is thankful there are such things as bypasses and auxiliary feed lines. They say "to hell with the regulator! We don't need it."

Every operator has his pet theory. If it's not the adjusting nuts on one type of regulator, it's the bellows on another, or the float on still another. So the bigger the sledge hammer and stillson wrench, the better to wreck the job.

To read books or study the subject is another joke. To look at a blueprint is a waste of time. The chief engineer usually gives a half-hearted order to go ahead and install it or fix it, then tosses the instruction book at the repairman. But if you read the instruction book, your buddies think you are mentally weak. Some mechanics abhor the idea of being caught reading instructions. So in some of the best industrial powerhouses, one finds a conglomeration of feedwater regulator hookups.

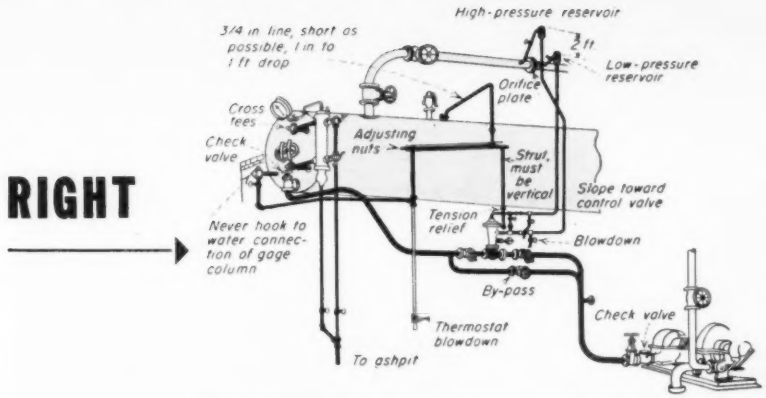
As an insurance inspector, I saw pressure regulators installed on turbine feed pumps with the diaphragm jammed tight against the casing. Or the overspeed governor setscrews twirled off by trying either to increase the pump speed or to check it. Feedwater regulators often have their thermostat jammed between piping and the boiler setting. I've also seen the vertical operating strut of one regulator, fancy with bends and kinks to duck around piping.

Drain valves are often in the wrong places, or just plugged up—because they leak. You might even find bad leaks at gland nuts and pipe fittings. I've seen water-column connections or even the column itself used for pipe hangers.

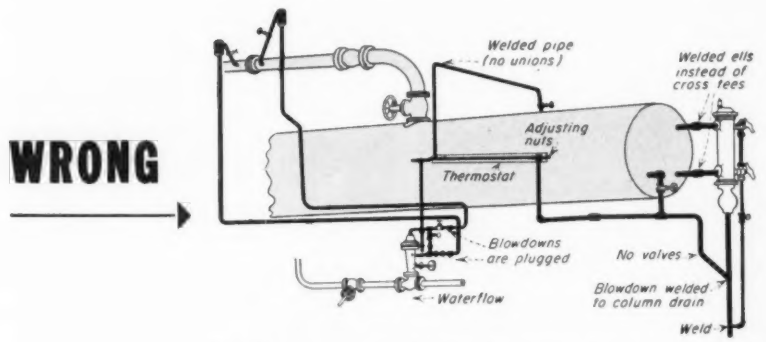
Maintenance. There isn't much maintenance on a boiler feedwater regulator if it's installed correctly. Instruct your men on right way to operate it and explain how the parts should work. Here, again, we meet chiefs who don't want their men to know anything. They even refuse to instruct them, fearing they might work into the chief's job.

There are three distinct types of feedwater regulators: Thermostat-mechanical, thermostat-hydraulic and float-operated.

In thermostat hydraulic types, also float-controlled types, trouble comes from poor maintenance. In thermostat-hydraulic type, someone is always changing the generator-tube angle. If it's placed correctly, some lunkhead blows it down as if it were a gage column. Or the metal bellows or siphon in the control valve-body is subjected to twisting and squeezing by some nuthead trying to adjust the valve lift. Then the bellows won't work because it crystallizes. Copper tube connecting the generator with the bellows is mistreated and begins to leak. So again the bypasses



GOOD HOOKUP of any regulator means following manufacturer's instructions closely. Unions, plugs let you keep piping free



BAD HOOKUP shown is what the author found in one plant. When water column was drained, so was automatic regulator

are used, and to hell with the regulator.

In the float-control type, the float chamber head is seldom removed to inspect the float and its linkage. Or no one examines the plunger valve until the float sinks from leakage through dents causing cracks. And as a result the boiler floods with water. Then the chamber is finally taken apart to see what causes the trouble. Usually some gink has blown the float chamber. So the men are always thankful for the bypass. I've even seen feedwater regulators bypassed when the trouble was a sediment-clogged float chamber.

Thermostat - mechanical regulator's main trouble is usually the men operating it. If the feed is sluggish, they use a pipe wrench to twist around the adjusting nuts of the thermostat "this-a-way or that-a-way." If the boiler feeds quickly, there is a mad rush for a ladder, and the nuts are twisted to yonder. If it isn't the thermostat, then it must be the plunger piston, and so the body is hampered. But if the dope had watched his steam line on the flow chart, he might have noticed that the load had gone off the boilers. This actually happened in one of those plants where a program of preventive maintenance was supposedly practiced.

My cartoon shows the regulator's valve-body being punished. The chain connecting the flow-actuating element is disconnected. Nobody ever thought about moving that element. Then the top head of the regulating valve body was taken off by the usual procedure of hammer, chisel, wrecking bar, block and fall.

Diaphragm was damaged, and the flowmatic spindle bent in trying to check something the men didn't know anything about. Off came the main body. Block and fall was used until finally the piston plunger was able to creep out of its bed of soda ash, lime and all the corruption surrounding it and adhering to the main-valve body side. Piping was heavily coated until pipe's area was cut in half. Outcome of this job was that boilers and piping were acid-cleaned to remove heavy sediment from piping.

To list all the needless troubles I've seen and the repairs made would fill books. I ran into the worst hookup of a thermostat-mechanical feedwater regulator in a new boilerhouse. There were several stoker-fired watertube boilers. After boiler installation, the piping and all appliances, also the regulators, had been left up to a welder. He also acted as pipe fitter. It was his pride and joy to point out the absence of fittings, and to show his welding ability.

Water-column connections to the boiler were welded with welding ells instead of cross tees, top sketch. Thermostat was erected correctly with all welded piping, but the water line from drumhead to thermostat was erected as follows: A 9-in. nipple threaded into the drumhead with a welded 90-degree elbow, then a 3-in. nipple, and a gate valve. Next was a length of pipe, which was welded to a horizontal tee.

Pipe from one end of the tee went to the thermostat. Other pipe with long-radius bends in it was welded to the water-column blowdown pipe or drain. The welder was then put in charge as chief engineer, last sketch.

When the operator blew down his water column, he automatically blew down the regulator water-line to the thermostat. That caused the regulating strut and flowmatic to open the piston plunger and surge water into the boiler.

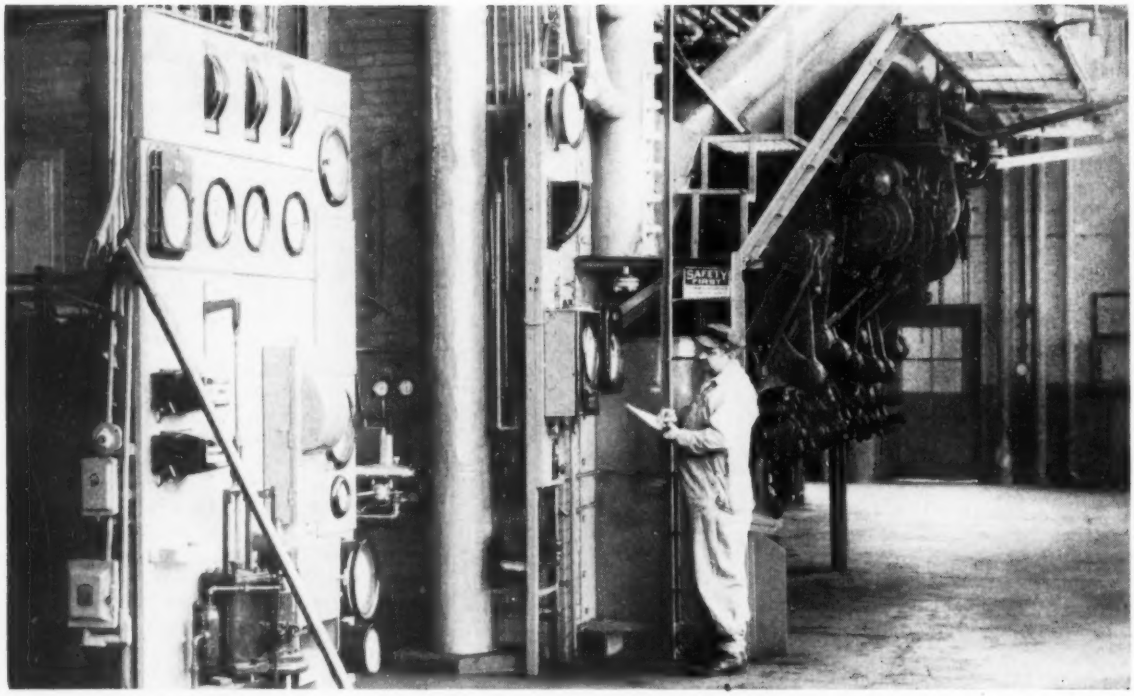
One day the "Chief" was asked about carryover to the plant caused by the piping setup. His reply was, "Oh, yeah? There used to be, but no more." Asked for a reason, here was his explanation:

"When the fireman on shift blew down the columns, they always blew the regulator. The sudden expansion of the thermostat tube would open the feedwater valve and the water would fill up the boiler drum. That gave us carryover.

"But I stopped that because I told the fireman to stop blowing down the water column on the day shift. Then one night, when the fireman had blown down the columns, there was a helluva-to-do in the plant. Water belched out where steam should have come out. I got hell, so I fired that fireman as an example. Now the water columns are tested ONCE A WEEK, because I know the boilers are clean, anyway."

Now in that state there are no license laws for engineers and firemen. When anybody says there are better engineers and firemen without licenses, then we should scrap what few license requirements we do have. Also, include our boiler inspection, and Natl Board of Boiler & Pressure Vessel Inspectors.

If an engineer is proud of his professesion, he would find ways and means to get an engineer's license, even though it meant going to another state to sit for the examination. Then there would be fewer boiler failures from faulty operation and maintenance of equipment.



STOKER INSTALLATIONS such as the one pictured above require careful start-up procedure if they are to perform efficiently

Planned Start-Ups Prolong Stoker Life

- ***Expansion stresses and strains in metal parts of stoker equipment reach maximum during rapid temperature changes from shutdown to on-the-line conditions***
- ***Operator hazards resulting from equipment failures or preparation oversights are most likely to occur during start-up***
- ***Definite advantages of shorter start-up periods can come only when operator follows carefully detailed lighting-up procedures***

► THE START-UP PERIOD is probably the most critical for any boiler equipment and it is at this time that potential hazards to operators are greatest. On the opposite page is a set of detailed instructions that, if followed carefully, can be a major factor in completely eliminating accidents during this operation.

This procedure shows how an industrial power plant burning one-third million tons of coal annually on underfeed and chain grate stokers outlines precautions taken to assure that units are properly prepared for use.

The units that supplied the data for this discussion were: (1) 8-retort underfeed stokers equipped with Stirling boilers of 55,000-lb per hr steaming capacity at 225 psi and 500 F, and (2) chain grate stokers with 70,000 lb per hr boilers operating at 275 psi and 550 F. Actual operator's written start-up procedure records combined with equipment manufacturer's check sheets form the backbone of this material.

Although the steps outlined here are admittedly very detailed, experience has shown that added care at this point of boiler operation materially increases efficiency and adds to the life span of boiler equipment.

Material for this article was adapted from *Lighting Off and Starting Up Precautions For Stoker Fired Boilers*, a paper by Herbert W. Andrews, Asst Steam Dept Head, Power Division of Eastman Kodak Co, presented at the Fall Meeting of the American Society of Mechanical Engineers.

UNDERFEED STOKER Recommendations

STEAM SYSTEM: Open all superheater header drains and automatic stop and check valve. Check steam line between boiler stop valve and automatic stop and check by opening drain valve at boiler stop valve. When line is dry, start bringing it up to pressure and temperature slowly with bypass valve open around boiler stop valve. When line is up to pressure, open boiler stop valve and close bypass valves.

LAYING THE FIRE: Set stoker secondary ram control in third notch (first notch—zero motion), set stroke adjusting valves for zero motion, start stoker-drive equipment, fill hopper, start stoker and run coal onto grates until secondary rams are covered to approximately half their length.

Uniformly distribute eight gal. of peteroleum fuel igniter (diesel engine oil jellied with aluminum soap) on coal in retorts near front wall. Smear one side of wooden sticks with igniter and place to bridge ponds of igniter. This will act as a fuse.

If fuel igniter is not available, pile wood one ft deep and two ft wide adjacent to front wall. Pour kerosene on pile and use this for igniter.

AIR SYSTEM: Close ash gates, sifting hopper gates, windbox access door, furnace doors, damper, front-wall and side-wall secondary air dampers. Open rear (stack) damper to minimum position on regulator. Place forced draft regulator in service to maintain automatically 0.1-in. furnace draft.

RAISING PRESSURE: Remember, to establish good ignition at front wall, slowly cover grates with fuel and obtain and maintain straight open burning lanes over tuyeres. To prevent damage, allow two hours from lighting time until unit goes on line.

Light igniter with torch through both front wall doors. When coal is ignited completely across front wall (approximately five minutes after lighting), start stoker at minimum speed in low gear. Lengthen secondary ram stroke as much as possible without losing ignition at front wall. Increase opening of rear damper as much as possible without affecting capacity of remaining units in service.

When pressure reaches 25 psi, throttle inlet superheater header drain to one turn open. When pressure reaches 100 psi, blow down feedwater regulator and blow down water column. As active fuel bed moves onto grate, apply normal stroke of 3-in. agitation, 2-in. push.

Stoker may be stopped to regain ignition at front wall, but to avoid damage, it should run at least one revolution every ten minutes.

AFTER GOING ON LINE: When boiler is on line, close superheater header drain valves. Manually lift all safety valves (four 3½-in. valves on boiler and one 2-in. valve on superheater). Enter record of boiler, valves and date in Equipment Record Book, use separate page for each unit. Place feedwater regulator, phosphate feed and continuous blowdown systems in service. Open impulse connection from steam drum to feedwater pump governors.

CHAIN GRATE STOKER Procedure

STEAM SYSTEM: Open all superheater header drains and automatic stop and check valve. Check steam line between header stop valve and automatic stop by opening drain at header stop valve and venting at automatic stop and check valve. When line is dry, bring up to pressure with bypass on header stop valve. When line is up to pressure, open header stop valve and close bypass valve.

LAYING THE FIRE: Carefully raise regulating gate to at least 12 in. Drop feed plates and frames to lower position. Spread 6 to 8-in. layer of coal under ignition arch and over No. 1 compartment. Just beyond the feed plates, make a shallow trough in the coal running entire width of grate. Uniformly distribute four gal (5 gal for No. 7) petroleum fuel igniter in this trough.

Petroleum fuel igniter is non-toxic and usually harmless to skin. As with kerosene, store igniter in covered container away from excessive heat. If fuel igniter is not available, use wood and kerosene as a substitute in the same manner as described above.

AIR SYSTEM: Close all setting access and inspection doors and ash gates. Close all stoker air compartment dampers. Open rear (stack) damper tight-closing device, then clamp damper about ½-open on regulator. Open windbox damper about half way and clamp.

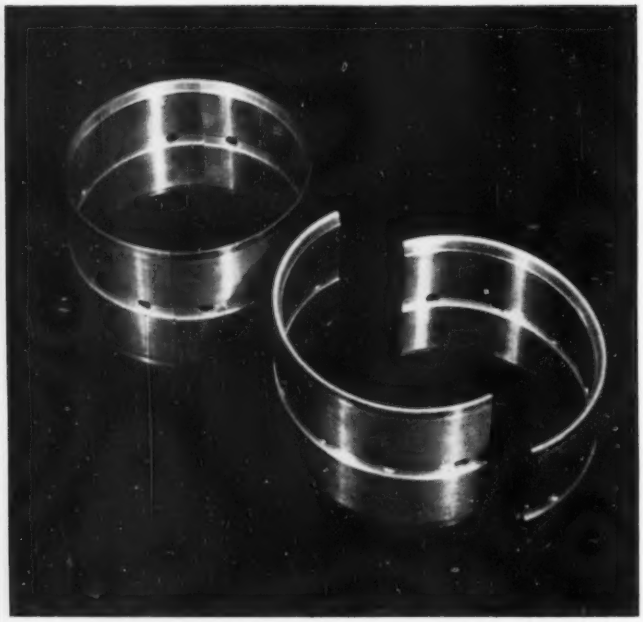
RAISING PRESSURE: Light fuel igniter with torch. When coal adjacent to igniter is burning, slowly open No. 1 air compartment damper and adjust to maintain furnace draft of –0.1-in. water. Lower coal gate to about 8 in., raise feed plate frames and secure with pins. Run stoker at minimum speed and add fuel. But don't fill hopper until entire bed is burning briskly and ignition arch is hot.

Open coal bunker grates and latch up coal spout swingers. When fuel bed reaches second compartment, gradually open its damper and readjust No. 1 and stack dampers to maintain furnace draft as above. It should not be necessary to break up fuel bed with bar at any time. Turn on cooling water on rear stoker roll.

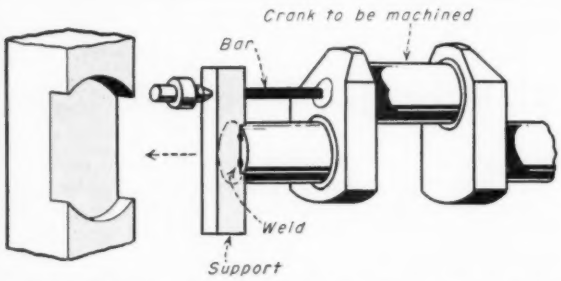
If wood is used for ignition, follow same procedure, but allow more time for ignition and spread additional coal on top of briskly burning wood.

At 25-psi pressure, close inlet superheater header drains. At 150-psi pressure, blow impulse lines to feedwater regulator and water column.

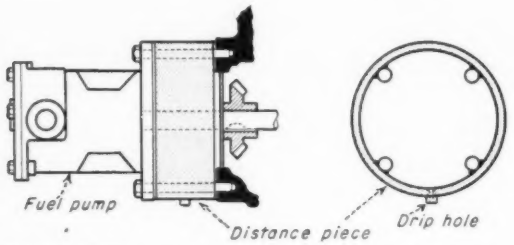
AFTER GOING ON LINE: When boiler is on line, close outlet superheater header drain, place furnace draft controller in service, adjust stack damper to suit load, open continuous blowdown valves, start secondary air fan and place feedwater regulator in service. Manually lift all safety valves. Enter record of boiler, valves and date in Equipment Record Book. Use separate page for each unit and sign each entry.



ALUMINUM-ALLOY shells turn with crankpin. Oil fills inside groove, goes through holes to outside groove, to wrist pin



CRANKSHAFT was lined up in the lathe centers between steel bars welded as shown and reinforced with a bar against webs



DISTANCE PIECE is made of 4-in. pipe between fuel pump and engine housing. Now oil from gland comes through drip hole

'We Had To Fix It Ourselves,' says John R Brown

- ***First, we removed grooved crankshaft of diesel, turned down crankpin in the lathe***
- ***Babbitt-lined bearings replaced with free-floating ones***
- ***New aluminum-alloy shells turn with crankpin, prove excellent for reconditioned pin***
- ***Other improvements added***

► BREAKDOWNS are bad enough in an industrial area, but when you're miles from nowhere, as we are down here in Bauta, Cuba, there is no nearby outside shop to depend on. Our own maintenance gang has to put us back in operation. We had a few emergency repairs come up that kept us awake, but recently we tackled our biggest job.

Our 450-hp 4-cycle 720-rpm diesel engine was operating at half load when the lube-oil pressure dropped suddenly from 55 (normal) to 46 psi. Engine also developed a strong knocking noise. We shut it down quickly. When it cooled, we opened the crankcase doors for an internal inspection.

Bad Bearing. We found crankpin bearing No. 6 (nearest flywheel) in sad shape. Babbitt shell was scored and crankpin badly grooved. Babbitt shell had moved and cut off oil supply to bearing.

In our engine, bearing is held tight by its own fit. Dowel pin in cap acts only as a locating dowel for assembly. It plays no part in operation. If pin wears, as ours did, it shows that bearing must have been loose. That also means connecting-rod bore wore, then chafed. A new bearing might not hold properly in assembly. As we had overhauled this bearing only a short time before, we were evidently at fault, and not the engine maker.

Crankshaft. Grooves in crankpin were deep, so we had to remove the crankshaft and turn down the pin. As every plant engineer knows, this is a major job, usually left to experts in an outside shop. But we had to tackle it ourselves—and do it without spoiling the expensive crankshaft. Otherwise, we would have had to order a new one from the States.

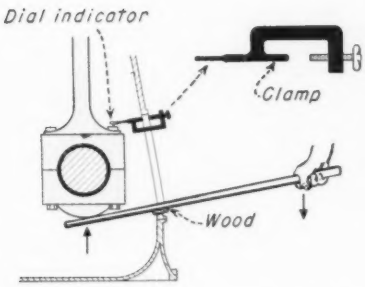
After dismantling the engine, we removed the crankshaft and then figured out a way to handle it in our engine lathe. First, we removed the flywheel. I learned that when a large crankshaft with counterweights is placed between lathe centers, shaft has considerable sag. This sag is not uniform when shaft revolves. Reason is that stiffness of crankshaft is not the same in all planes of rotation. So first job is to remove counterweights.

First headache was finding a way to hold crankshaft between lathe centers and in line with crankpin. Steel bar, 27 in. long and 7½ in. square, was our answer. We machined a recess to fit over crankshaft end to ¾-in. depth, top sketch.

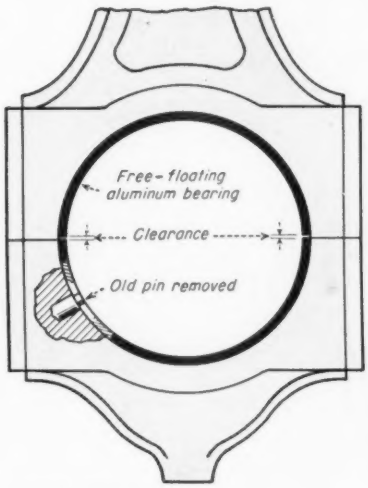
Bar was then welded to end of shaft in line with damaged crankpin. Next, we welded a reinforcing steel rod between this steel bar and crank web.

At other end, we placed a special support, built around a bearing, for crankshaft to revolve inside. Of course, shaft had to be balanced by attaching a weight

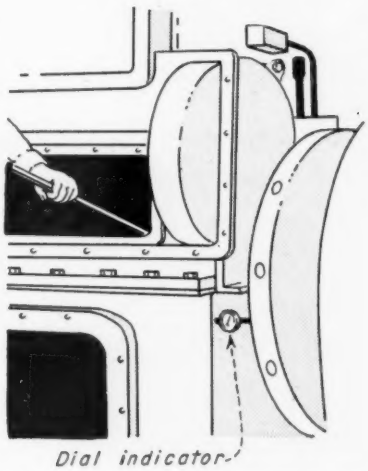
These Checks and Repairs Also Made



CRANKPIN bearing clearance is found with dial indicator quickly, accurately



DOWEL PINS failed in babbitt-lined bearing when it wasn't overhauled right



END PLAY is easy to check with dial indicator between flywheel and housing

to crank until shaft would not turn in lathe by itself when placed in various positions.

Next job was centering crankshaft by checking all main journals with dial indicator to see that journals were parallel with center line between lathe centers. Once crankshaft was in perfect alignment, we placed center drill in headstock of lathe and center-drilled bar for holding crankshaft between lathe centers. Both ends of crankshaft had to be supported as shown. Then we started job of turning down damaged crankpin. A few light cuts and polishing with fine abrasive cloth gave us a new but slightly under-sized pin.

New Bearings. Engine builder recommended full-floating aluminum-alloy bearings on reconditioned crankpin—and all other crankpins, photo. We had to replace No. 6 connecting rod and cap because bore was chafed. Then we removed dowel pins from all other connecting rods.

Here's something most engineers don't know about full-floating bearings. Bearing shell *revolves* inside its bore, at about half crankpin speed. That's right, it *revolves*. Aluminum-alloy shells have about 0.025-in. clearance between halves, center sketch, above. There are no dowel pins—no crush fit. Each shell half has oil holes through shell, photo, facing page. These holes connect with a groove from inside to outside. So oil supply-hole in crankpin lubricates both sides of shell and forces oil up to wristpin besides. When new bearings were installed, we checked clearances with dial indicator, first sketch above.

End Play. After reassembling engine, we wanted to make sure we knew correct end play of shaft. We placed a dial indicator between flywheel and casing, third sketch, above. By jacking crankshaft with a long bar against crankcase opening, indicator gave us exact axial play in thousandths of an inch. We find this method easier and more accurate than using feeler gage between thrust-bearing faces.

After 300 hours of operation, we opened engine and inspected aluminum bearings. All crankpins and bearings were in excellent shape, so we assume job will last a long time.

Lube-Oil Leakage. For some time we had oil leakage from the valve's rocker arms, caused by excess pressure in the lube-oil system. To solve this problem, while engine was down for crankshaft repairs, we installed a control valve and a pressure gage in the oil line leading to the rockers. This arrangement helps us keep right oil pressure and, therefore, does away with most leakage.

Fuel-Oil Leakage. Another headache was fuel oil that leaked into the crankcase of our engine. We take monthly analysis of our lubricating oil and it showed a low value in viscosity and flash point. This was caused by fuel oil leaking through seals of our fuel-supply pump.

For some time we had been replacing our pump shaft-seals periodically, but that still didn't solve leakage problem. Only thing to do was to place a distance piece between fuel-supply pump and the starting-air distributor housing, bottom sketch, facing page. Distance piece, of extra heavy 5-in. pipe, acts as collecting chamber.

Drive shaft had to be four inches longer because of new distance piece, which we also made. Now, fuel oil leaking from packing gland into this distance piece drains out through a $\frac{3}{8}$-in. drip pipe. There is no chance of lube-oil contamination. This should add to our engine's life in many ways.

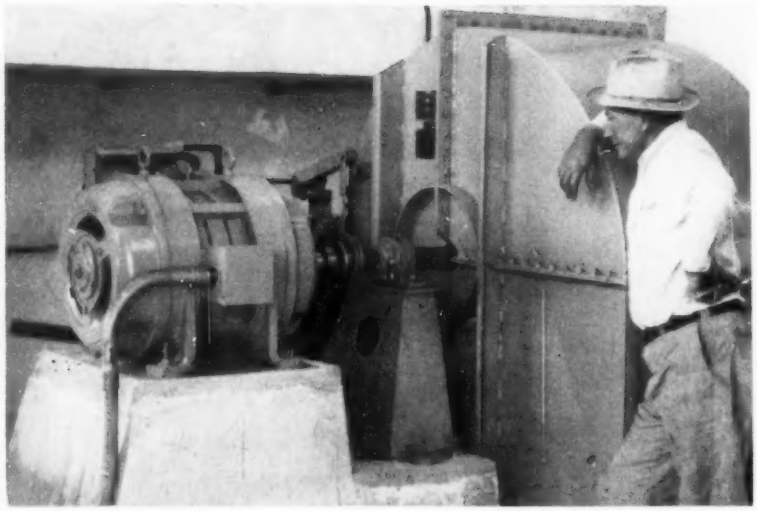
All the repairs I tell you about here have proved very successful. And so it naturally gives us a lot of satisfaction—stuck away, down here in the middle of an island—to know that we can solve our own problems without calling for help.

DID YOU KNOW . . .

that in case of bearing failure it is not good practice to reduce the fuel oil to favor the affected connecting rod? Other cylinders are thus overloaded, doing general damage to the diesel.

Any plant man worth his salt knows ball- and roller-bearing troubles can often be traced to poor maintenance practices. Here the author pinpoints the causes and cures for bearing headaches he's met up with in his years of field experience

By JIM SPARKS, *St. Louis, Mo.*



BEARINGS OVERHEATING? Check amount and type lube before blaming bearing supplier. Hold grease to one-third bearing capacity; oil to center line of lowest ball

Are You Pinning Down Causes for

► AFTER LIVING FOR YEARS with the practical problems that crop up in the field with ball and roller bearings, I've found they generally boil down to one of the following: *overheating, noise, vibration, shaft hard to turn—or the bearings just wear out too fast.* Here are the most practical answers when any of these symptoms show up.

Overheating. When a bearing has been rolling along doing a good job, and then suddenly start overheating, look into the lubrication done by the maintenance man. *Is the grease boy using the proper type grease or oil?* Proper according to the info provided by the lube supplier or bearing manufacturer? *Is there too little or too much lube in the bearing?* Where oil is used keep its level lined up with center of lowest ball or roller in bearing. And where bearing is grease filled, shoot for keeping it about one-third full, and no more.

Looking back over the years, I recall scads of bearing troubles that could be traced to overgreasing. That often happens with a bearing that's humming along doing a good job, then suddenly is reported to the maintenance department as a "heater." Often the overgreasing is caused by a lad imbued with the belief that a little is good, twice is better. When a housing is literally packed with grease, or oil level is too high, you wind up with excessive lube churning, high temperatures, oil leakage.

Seals can be at the root of your overheating problem too. Typical would be a bearing where felt is tightly packed in felt groove. Where leather or composition seals are used, excessive spring tension may be trouble source, or seals may be dried out. If felts are at fault, stretch them to cut friction; replace leather or composition seals with ones having less spring tension. Dryness can be licked by lubricating the seals.

You may meet the case where rotating seals are rubbing against stationary parts. Here, check running clearance of rotating seal. Correct alignment usually eliminates rubbing. I remember one instance where the oil-return holes were blocked and pumping action of seals led to oil leakage. Answer was simple: Clean holes, drain used oil and refill with fresh lube. Another time, overheating was traced to rubbing of shaft shoulder against bearing seals. Here we machined shaft shoulder to clear seal.

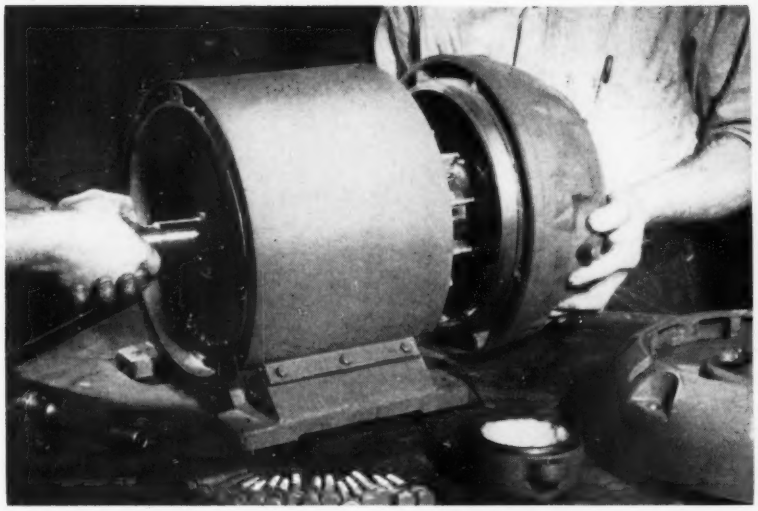
Poor alignment of two or more coupled shafts has accounted for many overheated bearings in my book. Solution always is to start fresh by getting close alignment and using flexible couplings. Don't start with sloppy alignment and expect the flexible couplings to correct it. They will to some extent, but as further misalignment creeps in with use, margin of safety, built in by flexible couplings, will have been spent.

Noise. Once again, lube system is best starting place when tracking down cause for noisy bearings. Wrong type of grease or oil may mean the bearing surfaces are not getting the lube film needed for quiet, long-life operation. Low oil level, either through maintenance neglect or because of loss through seals, may be the cause.

Check on foreign matter: dirt, sand, water, acid, paint. When any of these get into the bearing housing, expect noise and short life. In one case, I found it best to add a shroud around the bearing housing to serve as a dirt or water barrier.

In another plant, I traced bearing noise to a housing bore, out of round. Actually, the housing had warped. I found the answer in scraping the housing bore to relieve pinching of bearing.

Although I show motors above, don't



AFTER MOTOR IS IDLE for long stretch and exposed to vibration, carefully examine bearings for wear spots that may be separated by distance equal to ball spacing

UNBALANCED ROTOR may be cause for vibration. Here stroboscope makes check

Rolling-Contact Bearing Failures?

forget these same tips hold for pillow-block bearings. Some months back POWER ran an article on "Pillow Blocks for Long Shafting" (Feb 1953, pp 120-121). There the importance of using one free- and one held-type bearing assembly was well pointed out. I've run into cases where two held bearings were used on one shaft. Excessive shaft expansion followed with noise in its wake. My solution was to back off covers in one of the housings, then use shims to get the needed clearance of the outer ring so we had free axial-bearing motion.

Ever run against a shaft that was just too small for the bearing inner bore? This may come about through wear or from wrong-size bearing, used for replacement. Best bet is to metalize shaft and regrind it to proper fit. Don't overlook damage done when bearings are hammered into final position. Such damage can make itself known in a noisy fashion, putting it mildly.

Then there are the many mechanical rubbing problems that may come up, such as shaft shoulder rubbing against bearing seal, and lock-washer prong rubbing against bearing. In each case the answer is straightforward: Remachine shoulder, straighten prong, etc.

Vibration. Many of the trouble causes discussed can also bring about vibration: foreign matter, corrosive materials, housing bore out of round, shaft diameter too small. But there are a set of conditions that invariably point to and cause vibration. For instance, flat on ball or roller. Flating generally comes from skidding, a result of fast starting. Most practical solution is to examine bearing for flat spots and replace when necessary. "Pounding out" of housing bore can be traced to manufacturer's use of soft metal for housing. Result is an enlarged bore causing spinning of outer ring in housing. Best bet is to rebore housing and press in steel bushing. Then machine bushing to correct size.

Shaft Hard to Turn. Assuming you've checked through the lube side of the picture—proper type and amount of lube—look in the general direction of distortion, either of shaft or housing, for the possible seat of trouble. This is especially true as we look at bearings outside the electric motor. Typical would be inadequate shoulder support causing bending of shaft. Here I've found my answer in machining shaft fillet to relieve stress, but you may need a shoulder collar. Inadequate support in housing may cause cocking of outer ring. Once again, the answer lies in machining.

Distortion of bearing seals, shaft, inner ring may also be a factor. Or bearing seat diameter may be machined oversize, causing excessive expansion of shaft and bearing inner ring, thus reducing clearance in bearing. When you run into this, try grinding shaft to get proper fit between inner ring of bearing and shaft.

Too Frequent Replacements. Actually, all the factors we mentioned up to this point lead to a shorter bearing life. In addition, a worn felt-, leather-, composition- or labyrinth-seal leads to lube loss and dirt getting into bearing. Or the bearing-seat diameter may be undermachined, causing excessive expansion of shaft and bearing inner ring, thus reducing clearance in bearing. Solution is to grind shaft to get proper fit between inner ring of bearing and shaft.

In analyzing causes of bearing troubles keep in mind the friction as developed within a ball or roller bearing and how it's influenced by quantity of lubricant. It's not easy to account accurately for the friction in a roller-bearing. In addition to rolling friction, there's internal

(*Continued on page* 220)

Treat Your Compressor Seals Right

► SHAFT SEALS on refrigeration compressors prevent leakage of (1) gas and oil out of the crankcase and (2) air into it. Seals on modern high-speed compressors are often the spring-loaded type, Fig. 1. Another popular design, Fig. 2, uses tempered-steel diaphragms. In both, friction surface is much less than in a stuffing-box-type seal. In Fig. 3, unit has a bellows element.

Coil Spring. In this type, Fig. 1, the entire seal assembly rotates with the compressor shaft. Contact between the seal-face surface and its mating stationary seal seat forms the running seal joint. Both surfaces are highly finished so they are smooth and flat.

The seal face loosely encircles the shaft and is held tight against the stationary seat by the coil spring. Any gas or liquid pressure in the crankcase also acts on seal face, pressing it to the seat. But the spring furnishes main force.

Seal-face back contacts front of the resilient friction ring. This ring is closely fitted to shaft and prevents leakage at this point. Expansion of the ring is restricted by the friction-ring band, keeping seal tight at all times.

Diaphragms, Fig. 2, give a positive balance between internal crankcase pressure and external atmospheric pressure. Case-hardened steel collars retain the diaphragms, which are immersed in oil. Total friction surface is said to be less than 5% of the conventional stuffing-box-type seal.

Bellows. Seal nose, Fig. 3, carries a narrow ring with an accurately finished surface that is made to bear against a hardened-steel collar on the rotating shaft. Collar sealing surface is also highly polished. Flange mounts the seal assembly and the bellows provides a flexible and gas-tight connection between flange and seal nose. Spring maintains a firm contact between seal nose and shaft collar.

Leaks. Shaft seals seldom develop leaks if the compressor is run right. In good operation one of the most important items is the right amount of lube oil in the compressor crankcase. Keep the oil clean at all times and be sure it is the grade recommended by compressor manufacturer.

High-speed Freon compressors squeak or squeal when shaft seal is dry or scored. Stop the compressor as soon as you hear noises like this that do not come from drive belts or other parts of the compressor. Check crankcase oil level immediately. A damaged seal can lead to expensive repairs.

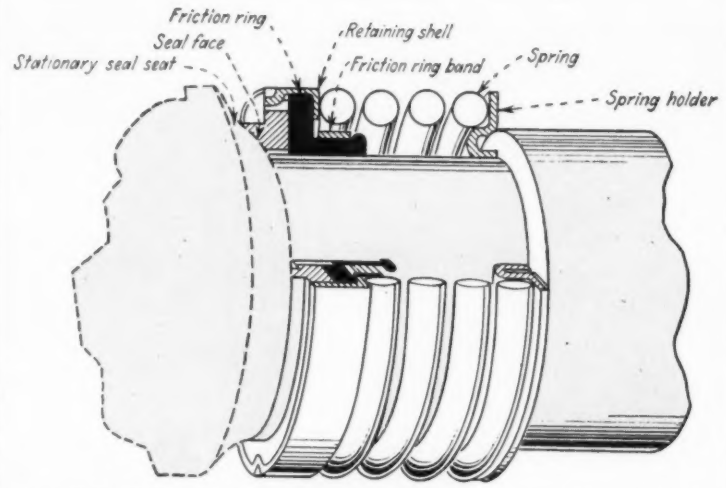
Once a week, during normal running, stop compressor and check seal for oil leaks. If much oil is found on seal exterior, test for refrigerant leaks, using a halide torch.

Seals like that in Fig. 1 may develop a slow leak when compressor is first started. Long storage or lack of oil between sealing surfaces is usually the cause. On most jobs, crankcase oil reaches the seal immediately after unit starts, establishes a tight seal again.

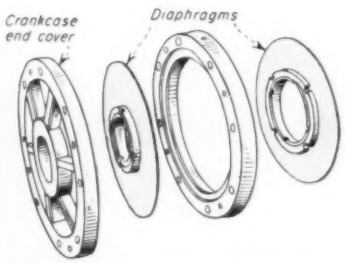
If leak doesn't stop within a short time after starting the compressor, shut the unit down and open seal for inspection. Handle its parts carefully because seal faces must be perfectly smooth to be effective. Deep scratches or grooves usually mean that seal must be replaced or reconditioned.

Choosing Seal. Life of a compressor seal depends on the basic design, proper finish of sealing surfaces and right installation. Seal must be suitable for shaft speed because there may be many variations in a unit suitable for 400 rpm and one built for 1200 rpm. So be most careful when replacing a seal to see that it is right for the speed, pressure, temperature, fluid conditions on your job.

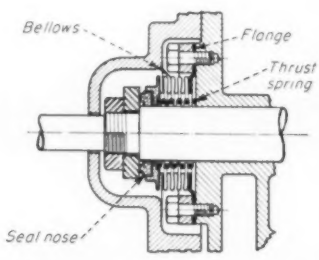
Maintenance. Your first rule in caring for seals is cleanliness, just as it is for ball and roller bearings. Don't unwrap a new seal until you have your work area spotless. Store seals only in a clean, dry place. Once the seal is installed, check it every week for liquid and gas leaks. Seals require little attention other than this; they'll run for years without trouble if properly lubricated.



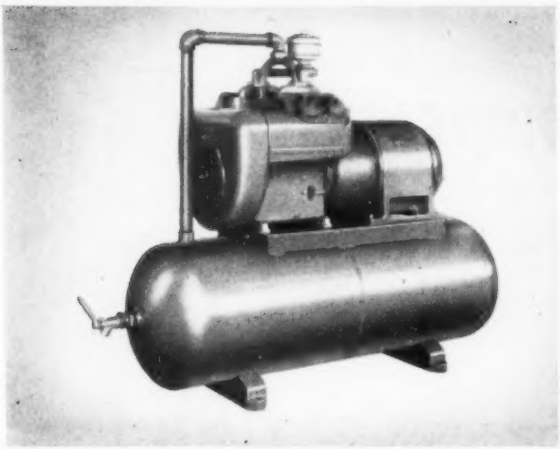
1 **SHAFT SEAL** fitted with coil spring to maintain pressure between rubbing, stationary faces. Friction ring, closely fitted to shaft, revolves with it



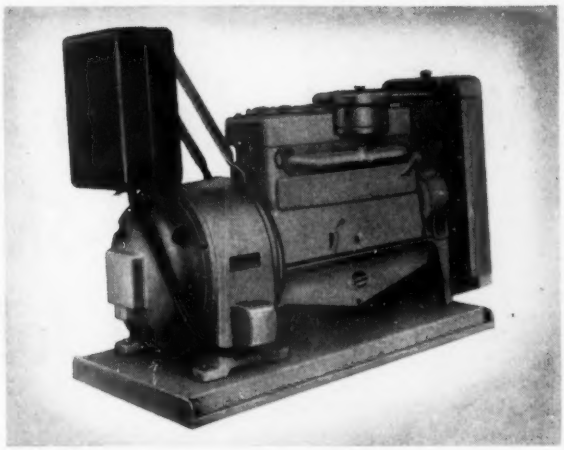
2 **BALANCED** packless shaft seal's two steel diaphragms run in oil



3 **BELLOWS** in shaft seal provides a flexible and gas-tight connection



1 Air-cooled garage-type compressor with 50-cfm capacity is easily installed, makes an ideal unit to be rented



2 Package-type compressor has motor, starter, radiator on one base, and is easy to install for short or long rental

SAVE MONEY!
Rent an Air Compressor

By LESLIE B SCHRAMM, *Secretary, Schramm, Inc*

► THERE ARE four reasons why you as an operating engineer may want to rent an air compressor. These are (1) to give extra capacity during peak-load periods (2) to prove that type of unit you have in mind is right for the job (3) to maintain production while your regular compressors are down for maintenance or repairs, and (4) for certain tax purposes.

Extra Capacity. Suppose you have a government or other short-run contract that probably won't be renewed, or a peak load once a year or at some other regular interval. Renting a compressor may save money because you won't have idle units for long periods.

Testing. If you're studying a new process or idea, purchasing one or more compressors may be a mistake until you decide on pressure, capacity, location, type. Either portable or stationary units are rented for production tests.

Production. Instead of losing all or part of your compressed-air capacity during maintenance or repair of your compressors, rent a unit. Either portable or stationary, it will keep production at normal while you or the manufacturer works on your regular units.

Tax Savings. Though the average operator doesn't have to worry much about taxes, he can help make savings. For example, monthly rental for a compressor can be charged off for taxes if no resale of equipment is planned.

Where to Rent. The idea of renting a compressor is fairly new. Usual procedure is to contact the local distributor for the make of unit you have in mind. Method of renting or leasing varies from one distributor to another.

Some distributors operate under a verbal agreement. Others use letter agreements covered by a purchase order from the user. But such systems have dangers for both user and distributor.

If user gets into money troubles, distributor may lose his ownership because the unit is bolted down in a bankrupt plant. Proof of ownership is extremely important in such instances.

To overcome this problem, many distributors use a retention-title contract. It is recorded in states requiring this, or other legal steps are taken, depending on local laws.

Besides recording the title, rental terms are stated, as is the percent of rent that can be applied toward purchase of the compressor, if the buyer decides he wants to keep the equipment.

Purchase. Most distributors establish a resale price when they rent. It is based on the use unit has had. If new, it carries the list price. If in rental service before, the price is less than for a new unit.

All calculations are based on the price established before the unit was delivered to the user. Usually about 80% of the rent paid may be applied toward purchase of the compressor. There is usually a time limit set after which the compressor may not be purchased with part of the rent paid on it.

Of course, if you rent a compressor for a long period, there comes a time when money spent for rent equals or is greater than the purchase price of the machine. So be sure to have competent legal advice before entering an agreement to rent an air compressor.

Maintenance. Agreement should define who is responsible for maintenance. Normally the user must maintain the unit at his own expense. But, of course, there is the normal guarantee period during which both the manufacturer and distributor give the usual service connected with this type of machine. Careless and wrong application by the user are his responsibility.

Types. You couldn't rent a compressor if units that are easy to install and remove had not been developed. Direct and V-belt-driven units from ½ to 150 hp lend themselves to rental. Most manufacturers have suitable units. Packaged compressors, Fig. 2, are well suited for rental.

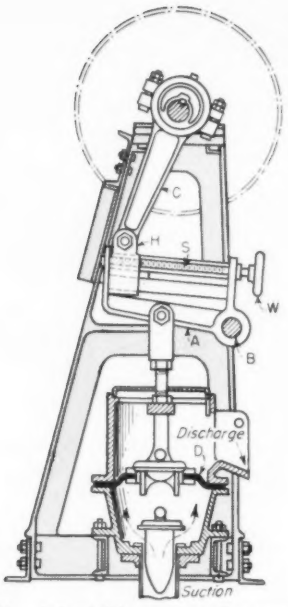
Some builders have receiver, starter, motor, compressor, aftercoolers and separators all on a single base for easy handling. Garage compressors, Fig. 1, are often rented. Normal rating runs to 15 hp. They are easily shifted.

When renting, be careful to consider compressor's installation cost. If you spend a large sum on a setup, the advantages of renting may be wiped out.

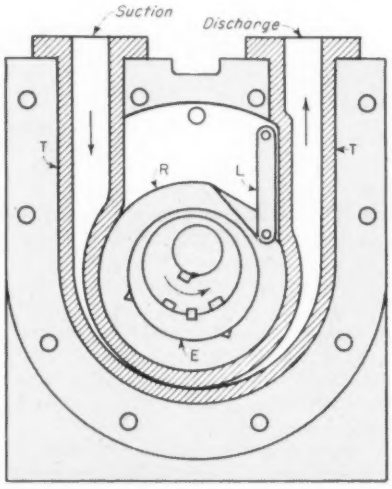
Why Diaphragm Pumps Do a Many-Sided Industrial Job

You can handle mild liquids or corrosive acids with these versatile units. The variable-displacement designs described here discharge metered quantities at either high or low pressures

By F A ANNETT, *Contributing Editor*



1 Handwheel W permits adjustment of the output while this pump is running



3 Rubber tube squeezed by a pressure ring is pumping element in this unit

► MANY APPLICATIONS of industrial diaphragm pumps require adjustable output. We get this by changing pump speed or adjusting stroke length. Since squirrel-cage motors often drive these units, their speed is not readily controlled except by using a variable-speed transmission between motor and pump. Transmission adds to cost, weight and size of the unit; also it must be maintained. That's why other methods of capacity adjustment find use.

Adjustable Stroke. Means for adjusting stroke length can be built into a pump to vary its displacement. Modern methods are simple, add little to pump size, have low maintenance, and are infinitely variable within their range.

Double eccentric may be used on pump drive shaft when adjustments are infrequent. This arrangement is the same as a single eccentric except that two are used, one outside the other. Inner eccentric is keyed to the drive shaft.

By positioning the outer eccentric around the inner, any stroke from about one-half to maximum is obtained. Though simple and low-cost, this arrangement requires that pump be stopped to adjust the discharge, and the adjustment is not too accurate.

Handwheel Adjustment. Many jobs require that discharge be adjustable while pump runs. Fig. 1 shows one method. Here diaphragm *D* connects to oscillating arm *A*, one end of which is supported by a bronze bearing on stationary shaft *S*. Adjustable head *H* connects the lower end of drive-shaft connecting rod *C* to arm *A*. Head can be moved from one end of the oscillating arm to the other by adjusting screw *S*, turned by handwheel *W*.

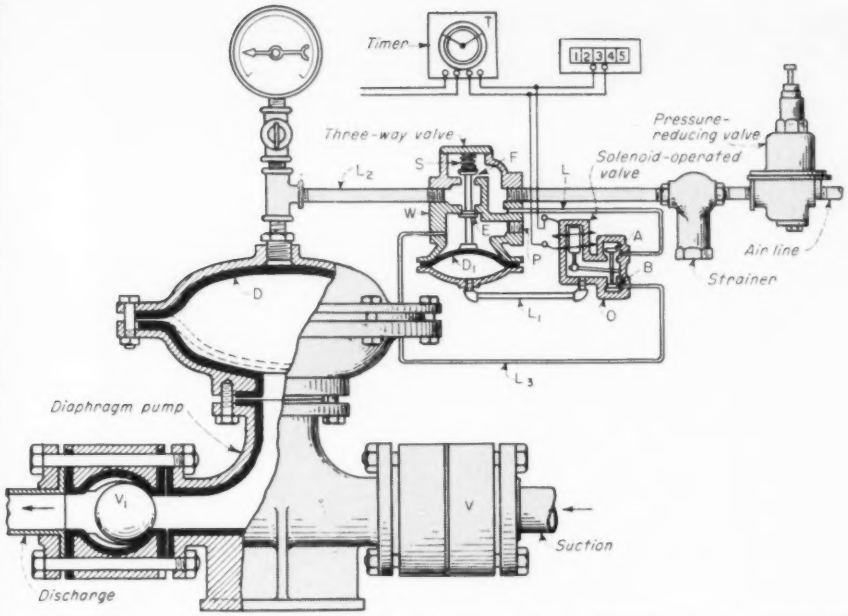
Moving crosshead *H* to the extreme left, as in Fig. 1, gives the oscillating arm and pump diaphragm the least up-and-down motion. In this position, stroke and discharge are the minimum. When crosshead is at the extreme right, arm *A* and diaphragm *D* have greatest motion; pump capacity increases and can be adjusted within design limits. At all stroke lengths the diaphragm connecting rod moves nearly straight up and down. This eliminates flexing at an angle, increases diaphragm life.

Piston Diaphragm. Some industrial jobs require that liquids be metered in proportion to some change in the process. For example, rate of flow of one liquid may have to be in direct ratio to flow of a second, though flow of the second may vary over a wide range, as in treating boiler feedwater. When controlling pH, flow of acids or bases must be varied. Or flow of liquid to a process may be regulated by liquid level in a column, or by pressure. On some jobs the liquid handled is corrosive so must be isolated from pump operating mechanism.

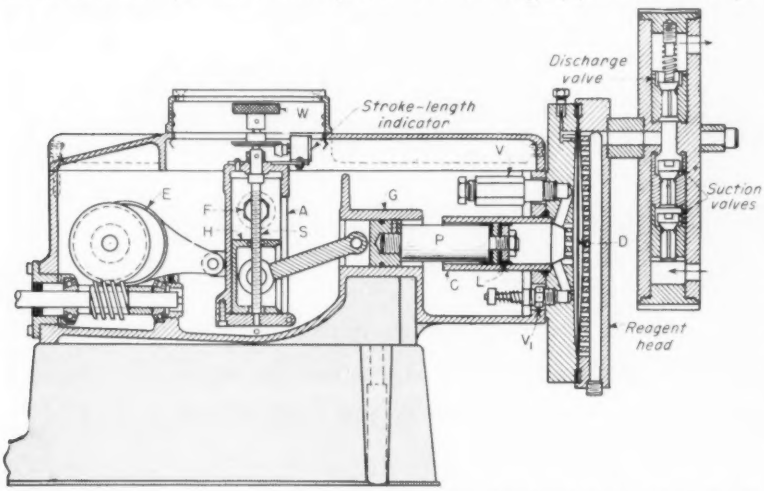
Fig. 4 shows a high-pressure variable-displacement pump developed for these jobs. It is a piston-diaphragm type with a chemical or reagent head and a power pumping unit. Head contains the suction and discharge valves. It may be porcelain, steel, iron, bronze, nickel, plastic, rubber, or any other material suitable for liquid handled.

Diaphragm *D* isolates the pumped liquid in the head and serves as the pumping element. Monel, stainless steel, nickel, tantalum, silver, plastic, rubber or other material is used for the diaphragm. Its movement is small to keep well within the material's fatigue limit. An 8½-in. stainless-steel diaphragm handling 0.66 gpm has a maximum deflection of 0.08 in.

Pump Head. Power end of unit is a honed and polished cylinder *C* in which piston *P*, with cup-leather seals *L*, runs.



2 Air-operated timer-controlled diaphragm pump is slow-speed type, running at 15 to 30 strokes per minute for capacities of 5 to 60 gpm, pressure to 100 psi



4 Piston-diaphragm pump has a chemical or reagent head and a piston-type power unit, isolated from each other by the flexible diaphragm of the pumping element

Pump head has a pressure-relief valve V and a vacuum-compensating valve V_1.

Piston P connects through guide G to the stroke-adjusting device A, which connects to a worm-and-gear-driven eccentric E. Diaphragm D is supported in a cavity between the power unit and reagent head to prevent deflection beyond its safe limit.

Pumping chamber to left of the diaphragm is filled with a hydraulic liquid, usually a special petroleum oil. However, glycerin, ethylene glycol or other liquids may be used for certain applications. When piston P moves forward, pressure on the diaphragm increases, deflecting it to the right to force liquid out the discharge valve.

Moving the piston to the left reduces the pressure on the diaphragm so it moves to the left, allowing liquid to flow through the suction valves into the pumping chamber, ready for the next discharge stroke. Since pressure on both sides of the diaphragm is the same at all times, the unit can operate at high discharge pressure. Normal operating pressure is 100 to 250 psi, but units of this type have been built for 5000 psi.

Stroke Adjuster. Stroke-length adjuster is fulcrumed at F and oscillates around this point to give the piston a reciprocating motion. With crosshead H in the position shown, the piston has its longest stroke and the pump discharges at maximum capacity. When H is moved upward until the connecting-rod pin centers on fulcrum F, the speed-adjusting assembly oscillates about F without moving piston P. Pump capacity is then zero. By positioning crosshead H on screw S with handwheel W, pump discharge is adjusted from zero to maximum while the pump runs.

If discharge pressure becomes excessive, relief valve V opens and bypasses liquid from cylinder C into a storage reservoir. Because of the liquid lost on the forward stroke, pressure ahead of piston drops below that in the reservoir on the return stroke. Vacuum-compensating valve V_1 then opens to return the bypassed liquid to the cylinder for the next stroke. As long as the discharge line remains closed, the liquid simply circulates between pump cylinder C and the reservoir. But when discharge line is open, each stroke of the piston delivers a metered quantity of fluid, determined by the setting of the stroke-adjustment device.

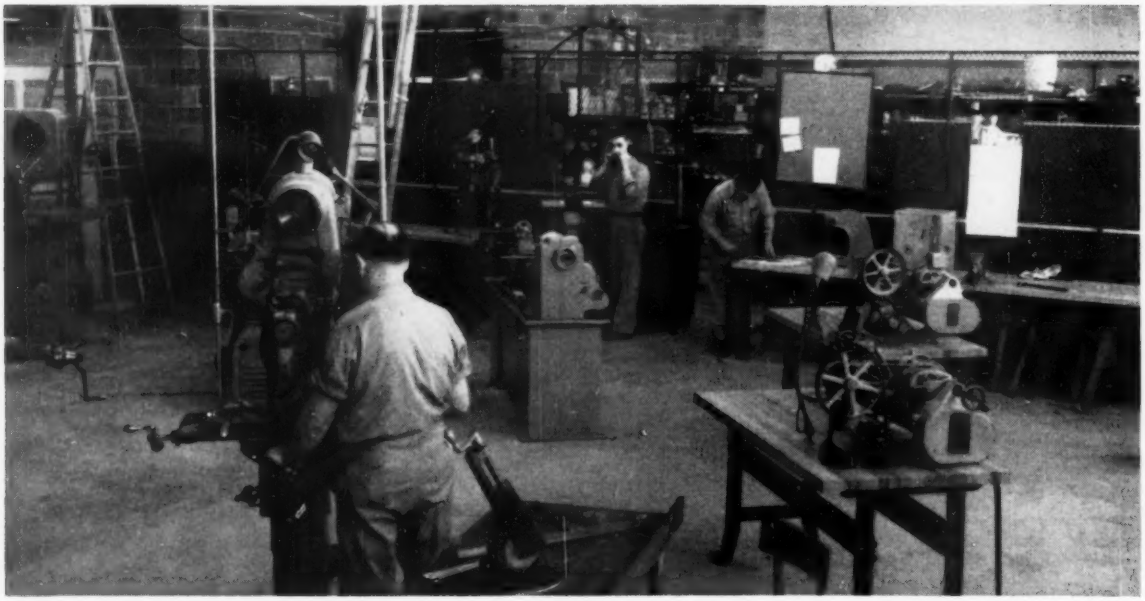
These pumps are motor-driven through a worm and gear at 58 strokes per minute, have capacities of 0.15 to 11 gpm for pressures to 1250 psi. They are built either as single units, or several may be assembled on a common base and driven by a single motor for handling a number of different solutions simultaneously.

Air-operated. For handling metallurgical slurries, chemical liquors, crystalline products, acids, foods, ammonia, brine and a wide variety of other products, compressed-air-operated diaphragm pumps, Fig. 2, may be used. These are slow-speed units, 15 to 30 strokes per minute, for capacities of 5 to 60 gpm and pressures to 100 psi.

Pump consists of a chamber containing a diaphragm D, ball-suction valve V, and a discharge valve V_1. Arrangement of valves forms a straight-through connection between suction and discharge lines. Solids won't clog the pump if they are small enough to pass the ball-valve ports. For larger solids, flap valves should be used.

Pump control consists of a timer T, solenoid-operated valve O and a diaphragm-and-spring-operated 3-way valve W. Applying air pressure under diaphragm D_1 closes valve E and opens F against the spring S. Spring closes valve F and opens E when pressure is released from under diaphragm. Compressed air flows to the top of diaphragm D through the 3-way valve. A pressure-reducing valve limits air pressure to 5 to 10 psi above that theoretically needed to operate the pump.

(*Continued on page* 214)



MAINTENANCE SHOP in the new Mennen Co plant at Morris Township, N. J., is well equipped with machine tools of various types that are a big help in keeping production facilities, building and the grounds in top-notch condition at all times

How to Build Easy Maintenance Into Your New Heating Plant

At some time or another, almost every operator complains about the design of his plant. Minor beefs are bound to pop up but the major ones shouldn't if you follow the schemes used by this modern firm

► THE MENNEN CO, manufacturers of men's toiletries and baby products, have a new plant at Morris Township, N. J., that should be an eye-opener to all operators with maintenance problems. For this is a plant in which the maintenance crew had its say from the earliest planning stages.

Maintenance Plans. When management decided to build a new plant, members of the maintenance department sat in on all meetings held among department heads. All essential needs for best care of building and grounds were studied. Maintenance head John Kuhl could request facilities, machinery and tools that would help his department alone. All he had to do was justify the expenses involved.

Work Crews. There are two groups in this plant. The general plant-maintenance crew is responsible for plant and grounds upkeep. Their work includes painting, electrical, carpentry, sanitation, heating, plumbing, grounds and plant protection. Production and warehouse personnel are responsible only to their own warehouse and maintenance-department heads.

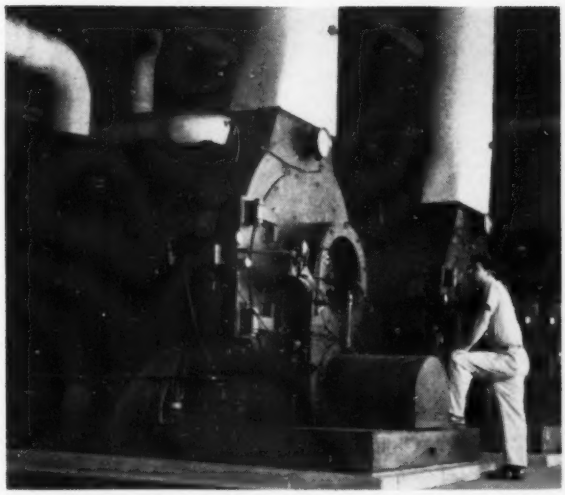
Safety. While the general plant-maintenance crew is responsible for plant protection, two committees take care of safety. One committee is made up of employe personnel; the other of supervisory groups. Safety recommendations are thoroughly studied before being accepted or rejected.

Maintenance Ease. Now just what can be done in a plant of this type to make maintenance easier? Here are a few examples that may help your plans.

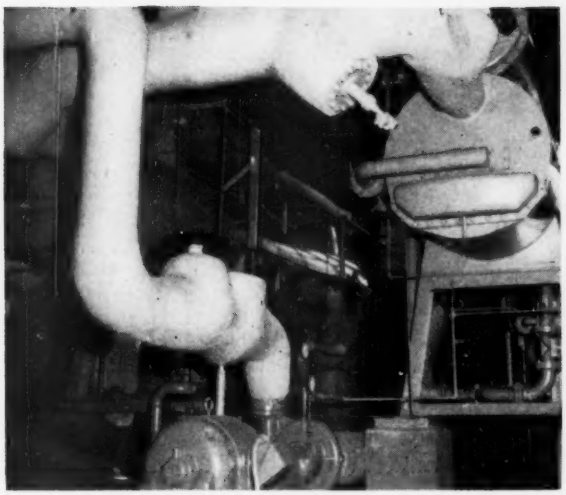
Wherever possible, ceramic tile, asphalt tile and soundproof acoustical board are used to keep maintenance painting at a minimum. Locker-room cabinets are placed on setback cement platforms that act as dust barriers. Service closets are strategically spot-zoned throughout office areas.

Aisle spaces throughout the plant are extra wide for easy passage. Dust-free floor in powder-manufacturing room keeps cleaning to a minimum in an area that is usually considered a problem child. Covered garbage-disposal dock allows easy removal, day or night, without entering plant.

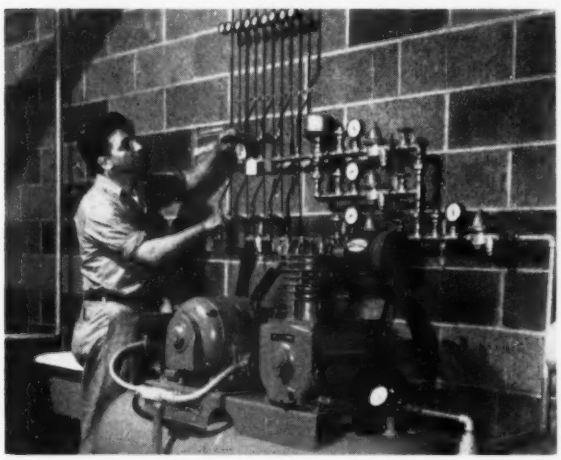
Egg-crate lighting with vertical louvers reduces amount of dust and dirt that can collect on fixtures. Louvers



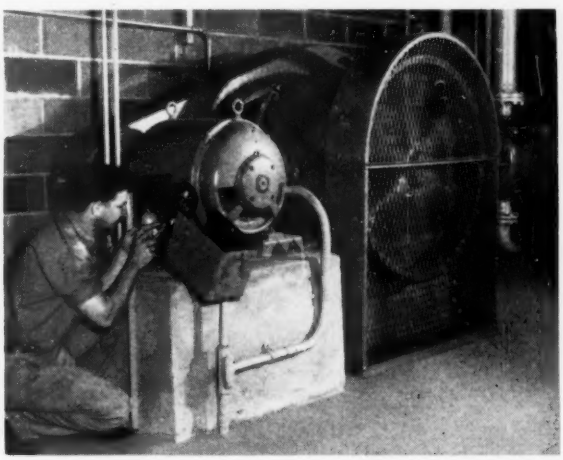
TRIM BOILER INSTALLATION has two units, each rated at about 12,000 lb per hr, to supply heating, air-conditioning steam



TWO 180-TON absorption refrigerating units cool water for use in the air-conditioning system, use 6840 lb steam per hr



NEAT PIPING hookup to this tank-mounted air-cooled air compressor permits easy checks of unit's output and condition



WORKING SPACE around a machine is always important from the maintenance angle. Operator here has plenty of room, light

are arranged to be washed mechanically. All utilities and sprinklers are above the luminous ceiling, so that entire area served by this lighting has a single uninterrupted ceiling.

Power Equipment. Two Cyclotherm package-type boilers, each rated at 12,000 lb per hr, supply steam for product processing, air conditioning, plant and office heating. Boilers provide 6840 lb per hr of steam to two 180-ton Carrier absorption refrigerating units. Plant and office spaces heated have a total floor area of 264,000 sq ft.

Chilled water from refrigeration units flows to centrally located spray-coil air-conditioning units where it is used for cooling and dehumidification. High-velocity ducts, about one-eighth the size of conventional heating ducts, carry cooled or heated air from the central unit to Weathermaster room units.

As it passes through the room units, the conditioned air induces a flow of room air over a coil in each unit. Chilled or warm water is circulated through the coil in the room unit. This gives room occupant individual control of the air temperature, since he can adjust water flow through coil to vary the amount of heating or cooling that takes place.

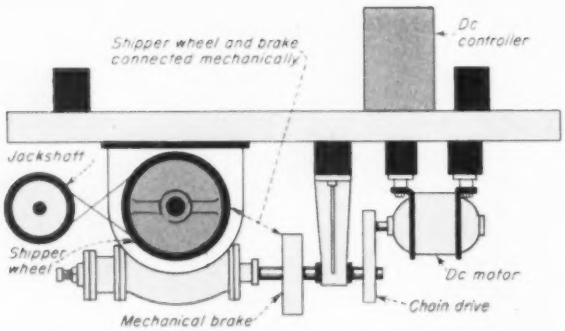
Seven central-system units supply conditioned air to factory areas. Another unit serves the cafeteria, two others the interior areas of the office space. All these use chilled water for cooling and dehumidification, and steam for heating the air.

Maintenance shop is well equipped with machine tools. By starting with a large area reserved only for maintenance operations, a better program can be set up and carried out. Storeroom location, directly behind the maintenance shop, saves time and steps.

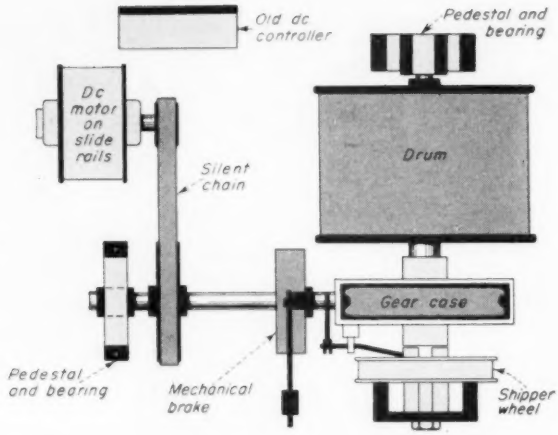
Water Supply. A decorative water pool fronting the new building provides water for process cooling and is a secondary source of supply in the event of a fire.

Volatile liquids used in manufacturing toiletries are stored in underground tanks on the plant grounds. Liquid ingredients of the various products are piped through meters to control stations. Valves, meters, gages and other units are located at the station so manufacturing processes can be controlled from one spot. Having the controls in one spot also simplifies plant maintenance.

BEFORE renovation

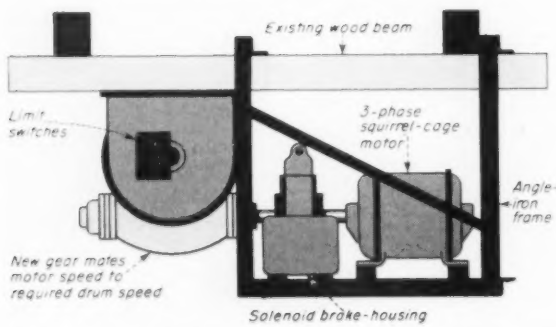


1 Foundry machine used cumbersome jackshaft arrangement to control elevator. Shipper wheel limited the car travel

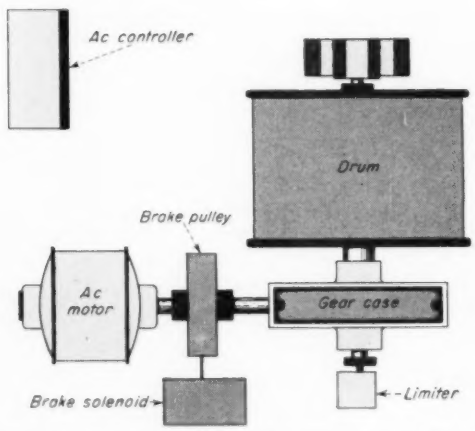


3 This machine-shop unit had fewer elements because it was mounted above the shaft. But it was just as obsolete

AFTER renovation



2 Modernized drive for foundry elevator eliminates chain drive and the obsolete hand-operated mechanical controls

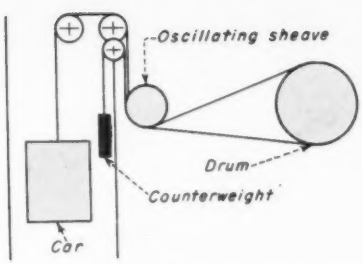


4 New controller occupies space formerly taken by old dc motor. Compare streamlining here with arrangement above

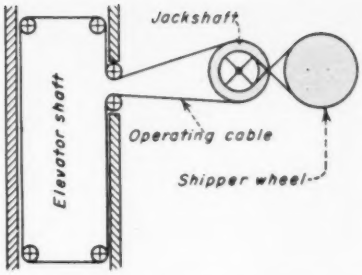
These Freight Elevators Modernized At One-Third Cost of New Units

By **WALTER J PRISE**
and **WILLIAM WILLEKE**
The Maintenance Co, New York, N. Y.

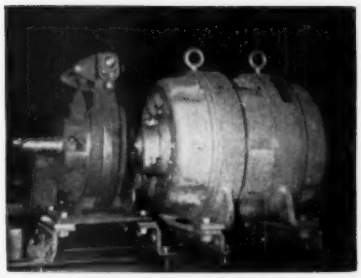
With maintenance costs zooming on their over-age freight elevators, the A P Smith Co carefully weighed modernizing against complete replacement . . . and modernizing won hands down. Here are the major steps in bringing both units up-to-date



5 Drive cables follow this course from the car through to the counterweights



6 Hand-operated cables provided the only means for controlling this car



7 This ac motor and electric brake now run the elevator in the machine shop

Revamped elevators incorporate many features of a new installation

► Because their drum-type foundry and machine-shop elevators were both unsafe and uneconomical, A P Smith Manufacturing Co of East Orange, N. J. decided to modernize.

Here's how these out-of-date units worked and how they were revamped to meet today's standards of performance and safety.

Old Units. Both elevator drives were overhead. In addition, they were similar: a dc motor transmitted the power through a sprocket, chain and mechanical brake, driving a worm gear tied in with the drum.

Foundry-machine power drive was attached to ceiling, but not immediately above the elevator hatch. This meant an additional set of pulleys and sheaves were necessary, Fig. 1. Hoist cables went from the drum through oscillating sheaves to a set of overhead sheaves above the elevator hoistway, Fig. 5. Oscillating sheaves moved back and forth in step with the drum motion, keeping cables in line. Two cables were used for safety.

Control was handled through an outmoded hand-operated cable arrangement, Fig. 6. Movement of hand cables transmitted motion through the jackshaft sheaves to shipper wheel. Then a mechanical connection from shipper wheel to mechanical brake completed the crude method of control.

Machine-shop elevator drive, Fig. 3, was, and still is, mounted directly above the hatch. It used a similar hand-cable control but it had a somewhat simpler arrangement because no jackshaft was necessary.

In both installations the worm-gear case was the solid type, with an opening at housing top. Worm-and-gear unit had an old ring-and-button thrust setup to keep worm centered.

Safety Devices. As might be expected in an installation of this vintage, very few safety devices were used. At landings there was an open-gate arrangement with no safety interlocks. Should the operating cables snap, elevator stopping depended on machine limit switches. If properly set, the machine would come to a stop. If not, the car would crash into the overhead beams or else it would land in the pit.

Modernized Units. All the safety features required in a modern elevator code are now incorporated in both elevators. The old dc motors, mechanical control lifts, chain drives and mechanical brakes were removed. Ring-and-button worm thrust bearings were replaced with modern ball-type thrust bearings, installed at rear end of gear case. This arrangement will simplify replacing thrust bearing in the future. Changing ratio of worm-gear drive permitted removal of the old chain drive and sprockets.

New polyphase, positive-action electric brakes supplant the mechanical brakes. A new ac full magnetic electric controller, operating from a pushbutton station in each car, replaces the obsolete hand-operated controls. And the pushbutton station also carries safety and light switches.

Now operator simply presses *up* or *down* buttons until he arrives at the floor desired. When he releases the pushbutton, the automatic electric brake stops the car smoothly. In addition, brake is such that if power fails the car stops automatically.

New ac motor is a heavy-duty elevator-type squirrel-cage unit connected to the worm shaft without a speed-changing mechanism. Note from sketch, Fig. 4, that new controller is in a more accessible position, actually the spot formerly occupied by the old dc motor. This will simplify maintenance and trouble shooting.

Cars are now enclosed with sheet-steel paneling. Their folding gates mount on overhead tubular tracks with ball-bearing rollers, and are guided by new grooved beveled-edge steel sills. For handling extra-wide loads, folded gates can be swung flat against the car. Switches prevent running this modernized car unless operator has fully closed the gates. This is an important safety feature.

All shaftway openings have counterbalanced vertical lifting gates, rigged up with electric bar interlocks. These gates must be fully closed and locked before car can operate. However, keys in a break-glass receptacle permit opening the gates from the floor side in an emergency.

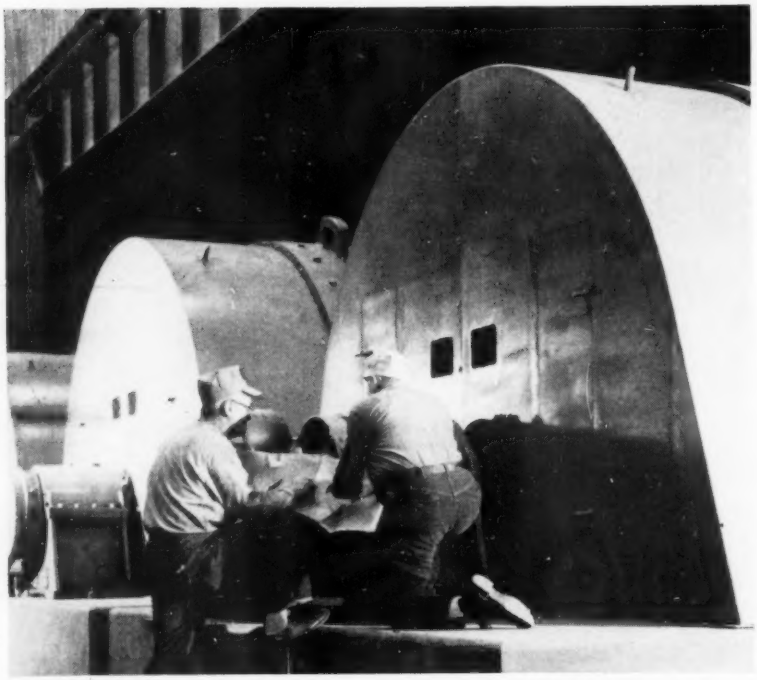
Terminal limit switches automatically stop the cab, level with top and bottom terminal landings. As a further protection, ultimate-limit switches installed on separate circuits will stop the car should the terminal limit switches fail. Both these switches are operated by a cam attached to car.

In addition, mechanically-driven machine-limit devices will cut off power if terminal and ultimate limit switches both fail. Car will stop before overtravel is sufficient to hit the overhead beams or the pit.

Each car has an emergency gate-release switch under a break-glass cover. In an emergency operator can run the elevator with the gates open. As an additional safety feature, the hoist cable has a slack-cable switch that can shut off the power.

Both these cases point up how elevator modernization pays off when properly handled . . . and at only a fraction of the cost of a new elevator installation. Many of the features of a new machine can be incorporated in a renovation job such as we have described.

Here Is a Review of Maintenance Practices In Step With Growing Use of Dc in Industry



By S SPENCE, *Cheshire, England*

FINISHING STANDS in Pittsburgh Steel Co strip mill use 4000-hp 600-v dc motors

Shooting Trouble on Dc Machines

SYMPTOM — **POSSIBE CAUSE OF TROUBLE: CURE**

General Overheating of Frame, Field Coils

1 Machine overloaded. Proper protective gear; fuses, relays, temperature detectors generally keep this symptom in check
2 High ambient temperatures. May be simple matter to improve ventilation with ducts, fans
3 Restricted ventilation through machine because of dirt in vent ducts or screens
4 If shunt field coils appear as heat source, check for shorted turns, too-high voltage, part of winding shorted-out
5 Where series field is overheating look for short-circuited turns; current density too high indicating wire size is inadequate; machine overloaded

Overheating of Armature Coils, Commutator

1 First make sure machine is not overloaded
2 Megohmmeter insulation test spots grounds; try for minimum of one megohm for units to 600 v
3 Individual coils may be shorted, open, incorrectly connected to commutator segments (adjacent leads to segments may be accidentally swapped in rewind)
4 Commutator overheating may indicate too great brush friction, contact drop. Here are some points to check: tarnishing of commutator (may stem from presence of gases from production equipment), rough surface, excessive brush pressure, wrong brush grade

Excessive Sparking at Brushes

1 Once again, make a close check on machine loading to rule out possibility of overloading

SYMPTOM — **POSSIBE CAUSE OF TROUBLE: CURE**

2 If brushes appear to vibrate when machine is running, check for eccentric commutator, low bars or flats, rough or grooved commutator. In each case the cure lies in turning, polishing commutator, preferably in its own bearings
3 If commutator appears distorted with some bars high, the answer is to "re-season." This means heating commutator uniformly to about 100 C, running full speed, then shutting down and tightening commutator bolts. Finish off with a fine stoning to take off any high spots
4 Commutator may be out of dynamic balance or vibrating at frequency of some external unit: namely, transmission gears
5 Do brushes slide easily in their holders?
6 Brushes may be off neutral; shift brush boxes to improve commutation
7 Brushes may not be equally spaced around commutator. Check this by actually measuring distances between all adjacent brushes; unequal spacing leads to circulating currents being set up
8 Incorrect brush pressure, brush type, unequal air gaps can cause sparking. Unequal gaps can stem from worn bearings
9 Open, short or loose connection in armature circuit. Open or shorted armature coils can usually be spotted at the commutator bar or bars connecting to the faulty coil; copper or mica will be burned. There may be signs of solder throwing out of the commutator joints where a loose connection is the fault
10 Brush arms and interconnections may have unequal

TIPS TO CUT DOWN THE NUMBER OF TROUBLE CALLS

GENERATOR OPERATION. Where a compound generator feeds a motor load, disconnect both electrically before bringing the units to rest. If both are left connected when prime mover is shut down, generator may come to rest before the motor, leaving the latter to act as a generator. The motor would then pass current through generator series field reversing its polarity. You'd then run into trouble on start-up if fields were not flashed first.

Where a shunt generator is one of several connected to the same bus, the field can be energized from bus by closing main machine switch *after* raising the armature brushes. But hang a resistor across field terminals to prevent voltage build-up when field is opened. Series field of compound generator will be energized in correct direction if equalizer and main switch are closed with armature brushes raised.

GENERATOR LOADING. If you run into trouble balancing load between generators where field rheostat is hand operated, try slight shifting of brush arms; forward movement increases, backward decreases. But you're limited by the effect brush-shifting will have on commutation.

Remember, for stable operation of compound generators in parallel an equalizer connection is necessary between inner terminals of the series field. For a true indication of load being carried, make sure the machine ammeter is in the generator lead that's not connected to the series winding. Otherwise, with current flowing in the equalizer, the ammeter would give a false reading of load distribution between machines.

MACHINE MAINTENANCE. Don't overlook the importance of staggering brushes on commutator to prevent grooving. By staggering brush arms in pairs you'll also reduce the tendency toward "copper picking" at brush faces.

I've found the following brush pressures work out best: carbon and graphite brushes, generally between 1.5 and 2 psi. Where motors must face up to heavy overloads it may be necessary to go to 2.5 or 3 psi. Still higher pressures are required for metal-graphite brushes; minimum about 3 psi.

INSULATION. There are three practical methods of measuring resistance of electrical insulation with a megohmmeter: (1) *short-time* or spot reading (2) time-resistance or *dielectric absorption* (3) *2-voltage* (POWER, June 1950, pp 116, 117). The short-time test is the most popular. But in the past some confusion has existed about when to stop the test since the value of insulation resistance would ordinarily keep climbing with time. So for purposes of standardization, 500-v dc applied for 60 sec is recommended where short-time single readings are to be made.

SYMPTOM — **POSSIBE CAUSE OF TROUBLE: CURE**

resistances, resulting in unequal current distribution in the arms. Thorough maintenance on all joints and terminals generally rules out this as a factor in brush sparking

11 Remember, a partially shorted or grounded main or interpole field winding upsets the magnetic balance much as would uneven air gaps

12 Are interpoles reversed? Check this with compass. Commutating pole for motor should have same polarity as the main pole *following*, traveling in direction of rotation. For a generator it should be same polarity as main pole *preceding* it, still considering the normal direction of rotation. At same time, check equalizer connections to assure that circulating currents are not at root of sparking

Motor Running at Other Than Normal Speed

1 Overspeeding of series motor generally indicates load was accidentally removed. Where a compound motor speed is unstable, check that the series winding is not reversed

2 A shunt motor overspeeds when field is too weak or a portion of the winding is shorted, grounded. Supply voltage may be too high. If it's running too slow, check for overloading, low supply voltage, short in field rheostat

3 Sudden speed and current spurts may mean a change in load, defective transmission, such as slipping belts or clutches. Where a shunt motor "hunts" it may point to commutator brushes that have shifted too far backward

SYMPTOM — **POSSIBE CAUSE OF TROUBLE: CURE**

4 Where a motor is to be reversed: Reverse either the field or armature leads for a series motor, reverse field leads only in a shunt motor, reverse both fields in a compound motor

Generator Fails to Build Up Voltage

1 No excitation may mean an open in field circuit, high resistance at joints or terminals—or the residual field may be lost. In the latter case, disconnect the field leads and separately excite from a dc source

2 Individual field coils may be reversed

3 Dirty commutator, low brush pressure, can build up contact resistance at commutator preventing voltage build-up

4 Is generator turning in proper direction?

Generator Voltage Too High or Low

1 Check speed and excitation amperes

2 Where voltage is low and field current OK, check for shorted portions of field coils. Also look into brush setting

3 If voltage is too low after the machine has been repaired, suspect wrong reconnection of fields, too large an air gap

4 If generators fail to share load evenly, machines may have different voltage characteristic curves. Also check through the excitation circuit

5 Where compound generators are unstable when paralleled, check equalizer connections.

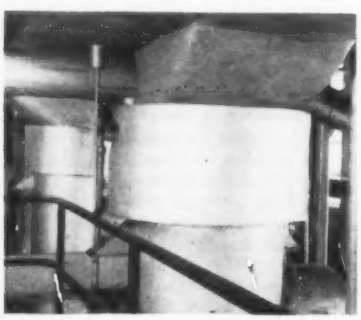
PRACTICAL IDEAS...*here's the trading post for your*

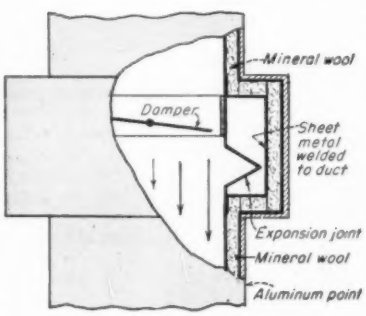
Pyrometer Tells When to Weld on Hard Overlay

PREHEATING castings to right temperature before welding on a hard overlay makes difference between success and failure.

This photo shows fast, accurate temperature indicator with attachment for this purpose. Just place hand pyrometer's thermocouple tip on heated casting, and one quick glance at instrument tells welder when to start laying on the expensive electrode for best results.

H MALIA *Schenectady, N. Y.*





Insulate Duct Expansion-Joint, Damper as Unit

WE REDUCED both installation time and materials cost in duct insulation by locating expansion joints and dampers side by side. Then we covered both as a unit. Sketch shows adjacent V-type expansion joints and damper flanges in circular air ducts covered in this manner. Single sheet-metal enclosure and banded mineral-wool block insulation does job.

Photo shows damper and expansion joint, located on one of three vertical ducts at intersections. They receive preheated air at about 620 F. Hot air is then delivered down through fans to pulverizers. Surfaces of both vertical and overhead ducts are insulated with one layer of 3-in.-thick mineral-wool blocks in 12x36-in. sections. Blocks are secured to the ducts with ¾-in. bands on about 9-in. centers, covered with wire mesh, and finished with a ¼-in. layer of insulating cement and a coat of finishing cement.

Standard 12x36-in. block sections are cut to fit three sides of sheet-metal enclosure over damper and expansion joint. While mineral-wool blocks are also secured with bands on vertical-enclosure surface, smaller insulation sections on enclosure sides are held in place by wire mesh. Enclosure insulation is finished same as regular duct surfaces. Photo shows insulating blocks cut around the damper-control lever on the left side of the duct.

H W SMITH *New York, N. Y.*

Mussels Die Young Now

AT LOS ANGELES, harbor water is brought in through duplicate conduits, either of which can carry almost entire cooling-water load, while other is emptied when mechanical cleaning is needed.

Station has operated since 1943. Until 1946, there was no conduit-fouling problem. Petroleum and manufacturing industries emptied high sulfides into the harbor waters. Sulfides killed marine life and corroded the aluminum-brass condenser tubes.

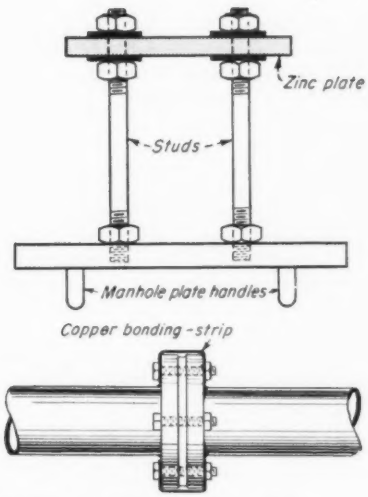
In 1946, harbor pollution was reduced. There was less hydrogen sulfide concentration. As oxygen in the waters increased, marine life began to thrive. Conduits, pumps and suction strainers clogged. Among offenders were bay mussel, a rock-boring clam, barnacles and vegetative matter, and other marine organisms.

H T Duplice read a paper on all this recently at the Los Angeles meeting of ASME. He told how he and C Alexander determined to kill marine life while it was still young. Reason was that shells would be small enough to pass through the entire cooling system to the discharge conduit.

A continuous chlorination system was first thought of, but this was too costly. After testing various possible methods, these men sealed off one circulating-water conduit at both ends to prevent water passage. This was done for five to seven days every four weeks during bay-mussel-spawning period. Mussels consumed oxygen in closed-off water and died when there was no more. After first test, when tunnels stop-log was raised, over 45 tons of dead marine life were washed out of conduit and into discharge basin. Method has been successful since June 1952.

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*



Steam Condenser Care

Idle Condensers: Keep water side of condenser either completely filled or entirely empty. If filled, circulate water often. If empty, dry tubes inside by blowing with air lance; drain steam side.

Water Side: Clean inside of tubes and waterboxes at frequent intervals, depending on deposits like slime, scale, mud, oil, grease, sea growths. For usual cleaning, flush waterboxes with warm fresh water; wirebrush lightly.

Clean tubes with air or water lance, wire-brush, or blow tube plugs through. Plugs are rubber, metal, rubber and canvas, or metal and canvas.

When cleaning tubes and waterboxes, clean and examine zinc plates. Renew zincs if more than half deteriorated. When reinstalling zinc, make good metallic contact to condenser.

Corrosion: Wasting away or thinning down of tube. Tube inside is evenly corroded without formation of pits or dezincified spots. Cure here is to install tubes of cupro-nickel alloy. Cause is acid in circulating medium.

Dezincification: Zinc is taken out of tube, leaving a spongy and brittle copper behind. It takes place irregularly, affects tube only in spots. Counteract by installing zinc plates in waterboxes. Water flow through condenser acts as electrolyte for flow of current between zinc plates and tubes.

Deposit Attack or Pitting: Small, round pits or pinholes beneath green salt and cuprite. Foreign deposits often accompany this type of corrosion. Low circulating-water velocity and stray electric currents intensify this corrosion. Binding copper wire around waterbox flange bolts and grounding to earth usually nullifies stray electric currents.

Tailed-Type Pitting: Pits formed by scale removal have deep section at upstream side and shallow trail at downstream side. Condition is from water flow through tubes. Only way to combat is to keep water flow as slow as possible. Keep zinc plates in condition.

Tube Erosion: Tube is worn away by action of solids in circulating water, often accompanied by corrosion. Low circulating-water velocity keeps this attack to a minimum.

Impingement Attack: Corrosion caused by air bubbles, and generally confined to tube's inlet end. This is uniform thinning or appears as grooving. Control circulating water so a slight discharge of water from waterbox vents minimizes this attack.

Scale Thinning: Scale kept thin by chemical action, resulting in corrosion and isolated pits. Zinc plates, causing scale formation through galvanic action, are effective here.

Solution: Scale absence due to presence of acids, etc, resulting in general thinning. Proper care of zinc plates will minimize this attack.

Splitting, Season Cracking: Splitting in a longitudinal plane. This is from improper annealing of tubes during making. Reject or replace such tubes.

Graphite Corrosion: Salt-water action on cast iron; in which cast iron becomes very soft and spongy. Best protection is to paint waterbox with coating of asphalt or cement paint. Paint acts as an insulator between waterbox and water.

Electrolysis: Caused by electrical action in tubes. Minimized by bonding all metal together, grounding to earth.

A D Collin *Washington, D. C.*

Old Auto Brake Opens Window, Holds in Place

Plant windows often open on a hinge at frame center as shown in photo. Windows are controlled and set with flat steel bar, fastened to bottom and notched so edge engages stationary member at sill bottom. Trouble is a slight jar that can upset bar closes window with a sudden bang. Or notches in bar may be spaced so you can't get the right ventilation without the drafts.

To solve our problems, engineers of Park St Bridge, Alameda, Calif. installed an old automobile hand brake for the desired controls in operating tower. Now each notch on pawl opens window about one inch, holds it easily without danger of accidental tripping.

G Burnley *Alameda, Calif.*

Watch Those Leads

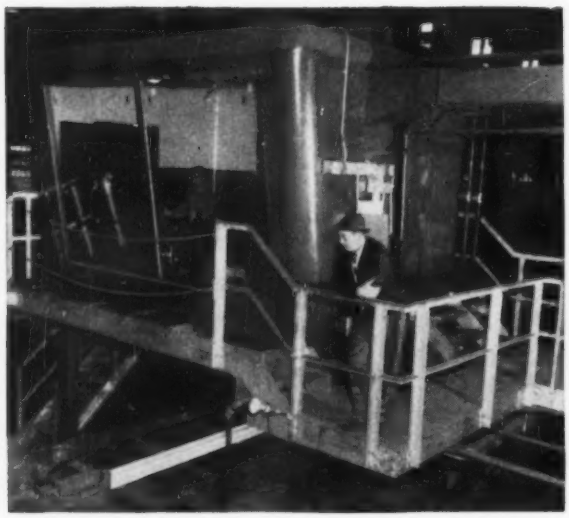
When you put your ohmmeter on the shelf, pull out the leads or turn the selector switch to Off or some other position than Ohms. Then, if the leads accidentally become shorted, the battery will not be discharged.

Ed Eckert *New York, N. Y.*

(*Continued on page* 132)

More PRACTICAL IDEAS

Begins on page 130



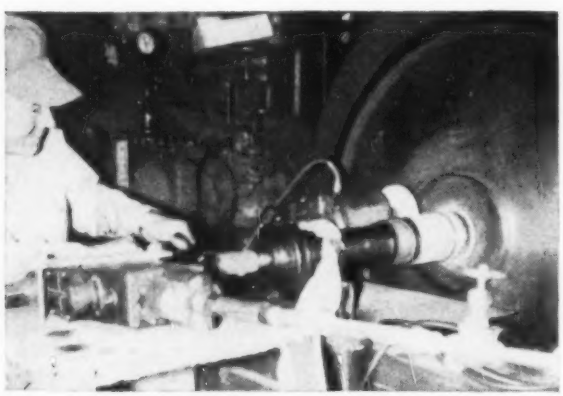
Air-Conditioned Cab Keeps Operator Happy

LIKE OTHER POWER ENGINEERS, I find keeping the services moving is only one of my headaches. Most of us soon learn comfortable employes are good business.

Control cab of any bloomer mill is hot because operator sits directly above hot steel that runs back and forth beneath him. To solve this problem, I ordered a small air-conditioning unit and connected it to cab with a duct. Now the cab is the coolest place in plant and operator has no more complaints.

N SEAMANS *Bridgeport, Conn.*

Seamans is outside cab with arms folded.



Turning Down Damaged Turbine Shaft in Place

WE INSPECTED and overhauled a 1500-kw turbine-generator used for standby service. This was first internal inspection in 12 years. We found turbine shaft under carbon seal-rings badly corroded and pitted.

Solution was to turn down damaged shaft and build up to correct dimensions with metal spray. We had no lathe. Problem was getting turbine spindle out of a cramped turbine room, to a lathe large enough for the job. So we used a temporary setup right in the building.

Spindle was cradled on double roller bearings at each end, mounted on heavy timbers and securely braced in every direction. We turned sprayed shaft with a hand-operated screw feed, using a cutting tool and grinder.

Shaft size is 4½ in. We cut down 3/64 in. and then metal-sprayed to 1/16-in. oversize. Spray metal was then cut back to about 0.020-in. oversize with a Carboloy-tipped cutting tool. We finished with a high-speed grinder, photo.

Work was turned with a 1-in. air drill, connected to thrust-bearing shaft, using a universal joint made of two sizes of pipe nipples. Larger nipple was fastened to shaft with setscrews, while smaller was welded to an old drill shank. Two nipples were pinned together with a loose-fitting bolt.

We installed end braces with a ball bearing in center bore to take up end play on one end. Ball bearing, turning on dummy wheel, was used on the other. Ball-bearing cradles were boxed in, and boxes were filled with grease to prevent wear on shaft.

Time was a little longer than normal as 2½ days were used for the job.

M GIBBONS *Vienna, Md.*

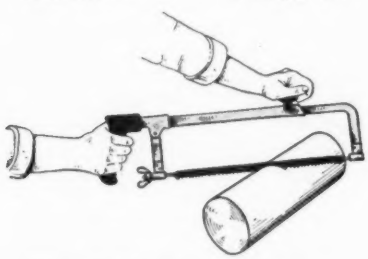
Emergency Feed Pump

OUR PLANT generates all electricity and steam, with no connection to the utility. One day a tube broke in one of two steaming boilers. In the shuffle, both boilers were knocked off the line. City-water pressure was not enough to fill the boilers. With no steam pressure or power, a fire engine had to fill boilers.

To solve problem, we installed a simplex pump with suction from city-water main. Pump discharged into boiler feed line. We used a 250-cfm, portable, 100-psi gasoline-driven air compressor to supply air to the steam cylinder.

If we lose all our steam pressure again, we should be able to get back on the line in two hours instead of the 12 hours needed in last shutdown.

M E EVANS *Chicago, Ill.*



Door Knob Helps to Saw

METAL DOOR KNOB on end of hacksaw helps put pressure on saw to go through heavy work. Just split knob's shank with saw so it fits over frame as shown. Then braze in place. This arrangement not only helps do a faster job, but also prevents skinned knuckles.

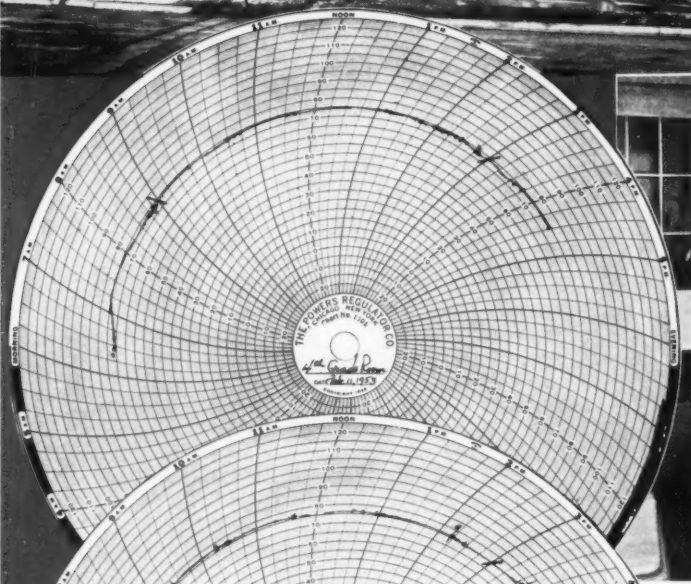
A R TANNER *Cold Spring, N. Y.*

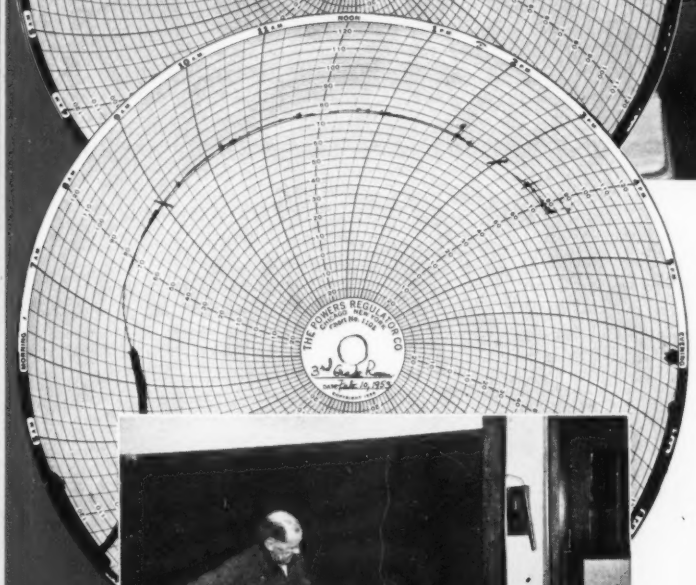
(*Continued on page* 134)

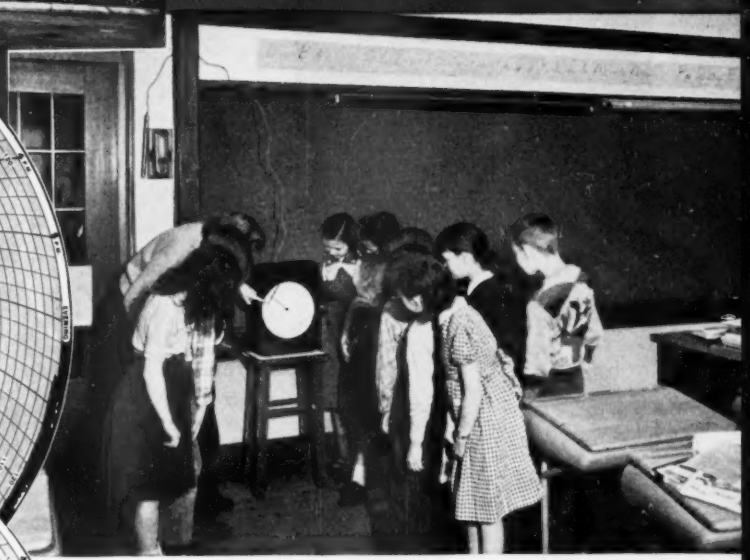
IN 1924 the **BANTA SCHOOL**
In Valparaiso, Indiana was equipped with

POWERS

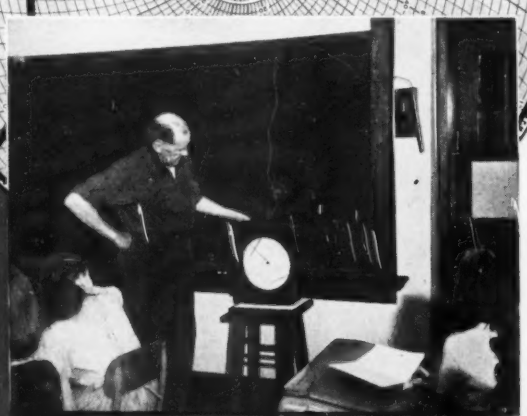
Pneumatic System of
TEMPERATURE CONTROL







Miss Chelf, teacher and pupils in fourth grade inspecting Recording Thermometer chart record shown at left. Powers Type K Thermostat was set for 75° F. Note even control during school hours.



Chief Engineer Mr. Joseph Kotscheid setting up a Recording Thermometer in one of the rooms in the Banta School Valparaiso, Ind. Thermostats were set for 75° F.

After 29 Years

Charts like those shown at left.

Will the Temperature Control System you are buying today give as good regulation as this when it is 29 years old?

Again and again 25 to 50 year old POWERS pneumatic systems of temperature control pass recording thermometer tests with high marks.

Why make a major investment in a control system that has no proven record for long life, low operating and low maintenance cost? Get the most for your money. Install Powers.

Maintenance cost on this job was 11% of the installed price 29 years ago.

(b45)

THE POWERS REGULATOR COMPANY

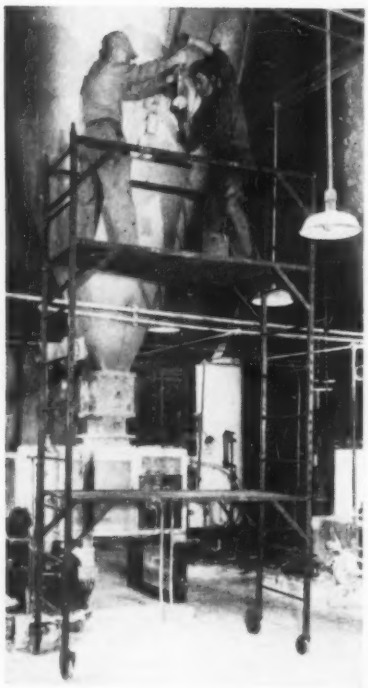
SKOKIE, ILLINOIS

OFFICES IN OVER 50 CITIES IN U.S.A., CANADA, AND MEXICO • SEE YOUR PHONE BOOK

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

More PRACTICAL IDEAS

Begins on page 130



"Do Your Scaffolds Save Workers' Lives?"

HERE'S WHAT National Safety Council says about scaffolds:

"Accident reports show that neither management nor workers give enough attention to using scaffolds. Whether for temporary or permanent use, scaffolds must be of rigid construction.

Makeshifts

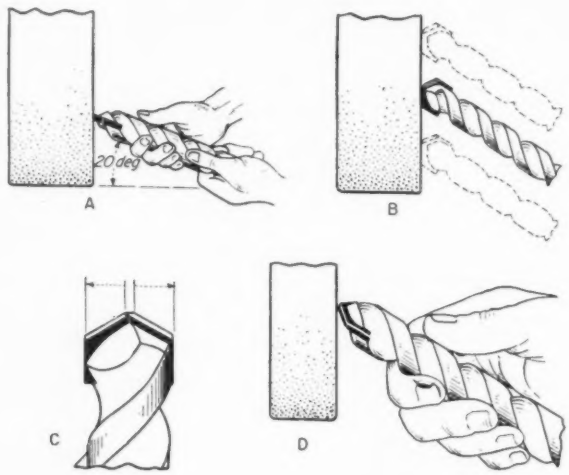
"There's no such thing as a temporary scaffold; it may be erected for temporary use, but if needed at all, it must be built properly and fastened securely. Scaffold used for only one day must be just as strong as one for a month—a man does not weigh less just because the job is of short duration.

"Many workers are injured when makeshift scaffolds, which were hurriedly erected for quick jobs, fall, break, or do not protect workers from falling. It's up to management more than workers to see that such scaffolds are not permitted for use in any plant.

Specifications

"Only if management has a definite, clearly defined policy regarding scaffolds will workers make and use this equipment properly. That means specifications must include type to be used and exact design, with emphasis on safety devices as guard rails."

L S METCALF *New York, N. Y.*



Sharpen Tungsten-Carbide Right Way

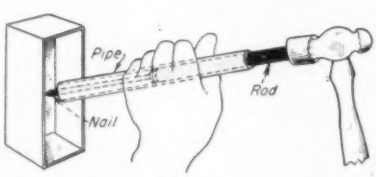
HERE ARE FOUR STEPS to sharpen carbide-tipped masonry drills, suggested by Carboloy Department of General Electric Co.

Use a silicon-carbide wheel (C100-18V or C80-18V) for restoring original 118-deg included angle. Sharpen drills when 1/64-in. or more flat develops on cutting edge.

A. Bring drill against grinding wheel's side at 20-deg angle. Maintain this angle; otherwise, drill won't cut properly. *B.* Move drill back and forth across wheel to avoid overheating. If the drill should overheat, don't drop drill into liquids in order to cool it.

C. Keep drill's two cutting edges of equal length while sharpening. If edges vary in size, drill will make cuts oversized. *D.* Resharpening drill often reduces clearance between carbide tip and steel shank. When needed, grind steel away from behind carbide tip so steel is nowhere closer than 1/32 in. to working surface of carbide blank.

Drills can be sharpened on either a pedestal or bench-type grinder. If you must sharpen drill on job, mount portable drill on a stand and use small silicon-carbide wheel for best results.



Driving Nail in Tight Place

HERE'S AN IDEA for driving a spike or nail in a tight place where you either can't hold the nail, or must stick it into a narrow place and then can't hit the head. I have used the idea many times.

One use is fastening conduit boxes in your shop. Place nail in pipe about same inside diameter as head of nail. Slide solid rod in pipe. Then hit stock, and nail will travel. This tip is also good for driving nails in up-side down. If pipe and rod are long enough, you can stand on floor for most ceiling jobs.

N G NELSON *Aurora, Ill.*

Allow for Pipe Expansion

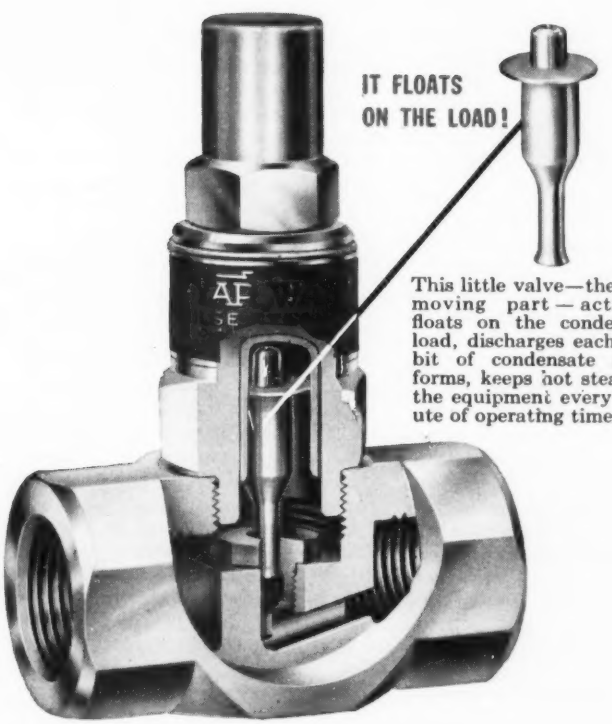
IT'S COMMON practice to install straight steam pipe with little, if any, allowance for pipe expansion. As a result, dangerous stresses set up in pipes and auxiliary connections when under steam.

To take care of these elongations in places where bends are impractical, or where they should be avoided, we made the pipe slightly shorter. We allow a small fractional part of an inch for every ten feet of pipe length. The longitudinal stresses in pipe, when cold, then have tensional stresses. Hence, should any pipe length be taken out, a bolted flange-pipe easily drops out.

Make calculations so when pipe is under steam pressure, shortage is taken up by expansion. Then pipe has no longitudinal stresses whatever. So, besides making it easy to renew a gasket, this method is good for long pipe life.

J H SQUIRES *Newark, N. J.*

3000 impulses help keep mid-west refinery "on stream"



This little valve—the only moving part—actually floats on the condensate load, discharges each tiny bit of condensate as it forms, keeps hot steam in the equipment every minute of operating time.

THIS big refinery at Lawrenceville, Ill.—like a lot of other important refineries — uses Yarway Impulse Steam Traps.

Over 3000 Yarway Impulse Traps are installed on tracer lines and for draining steam headers.

Popular features of the Yarway Impulse Steam Trap are its ability to get equipment *hot in a hurry*—and keep it hot! . . . also its small, handy size—fits in easily in any location; its stainless steel body and working parts; quick installation; easy maintenance; low initial cost.

Another advantage—IMMEDIATE DELIVERY from 250 local distributors, plus quick service from nearby Yarway field engineers.

More than 900,000 Yarway Impulse Steam Traps have been sold. For a free Steam Trap Selector, write . . .

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY® impulse® steam trap

PLANT PROBLEMS... *put your know-how to work*

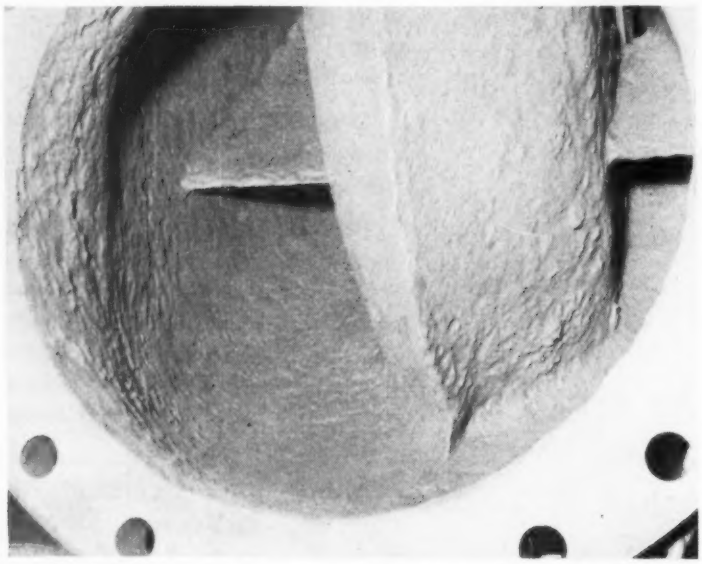
Question No. 1: How Can We Stop Erosion of Pump Casing?

HERE ARE THE FACTS: Our four sea-water circulating pumps are driven by 100-hp 57-rpm induction motors. Lift is about 6 feet; discharge resistance is about 7 psi.

Photos, Sept p 134, show one rotor after six months' use. It is badly corroded and had to be replaced with a neoprene-coated unit. After one month we removed the new rotor for a look. It was in good condition but casing showed signs of severe erosion; it appears attack on casing is worse than on rotor.

What's the best way of protecting these casings? Our plant is a long distance from any repair shops, and we'd like to do the work ourselves, if it is at all possible.—*MC, Sept Power*

Here Are the Answers



THIS PUMP CASING was in a badly corroded and graphitized state before overhaul

PHOTO SHOWS a pump casing in a badly corroded and graphitized state. During overhaul the graphite was removed and the interior of the casing coated with neoprene to a minimum thickness of 0.045 in. Since the coating was applied the pump has run for one year and shows no further wear.

MC's best bet is to have the work done by a contractor specializing in these jobs. Application in the plant is difficult if you do not have the right tools and equipment.

Standard centrifugal pumps for sea or salt water have cast-iron casings and bronze trim. But, depending on local conditions, use all-iron, all-bronze, or iron casings with stainless fittings.

Sea water, contaminated, as in harbors, can give trouble if pump has fittings of standard materials. Failures are caused by galvanic action between the bronze parts and the cast-iron casing, which graphitizes and is eventually a total loss. With a high suction lift, galvanic action is accelerated because oxygen is released from the water.

While an all-iron pump avoids the electrolytic action between bronze parts and cast-iron casings, the action may still occur. Some iron dissolution may take place, leaving graphitized areas. They act as cathodes to the cast iron, and the resulting galvanic action is self-accelerated.

To avoid graphitization and poor resistance to cavitation of cast-iron impellers, these and other small pump parts may be of stainless steel. However, an all-bronze pump should give the longest life for sea-water conditions. Some all-bronze pumps, handling sea or harbor water, have lasted for more than 20 years on many jobs.

DON KELLAND *New York, N. Y.*

THIS PROBLEM can be extremely difficult when a plant is a long way from repair shops. I sympathize with *MC* because the distance from shops multiplies his troubles.

Clean out pump casing, especially around erosion scars. Then apply metal cement directly to scarred area. If scars are more than ¼ in. deep, apply the cement in layers until the surface is level with the rest of the casing.

Allow cement to dry thoroughly and then surface-grind to a smooth contour. If desired, a zinc coating may be applied over the entire interior of the casing. Spray it on, using a thickness of 0.01 to 0.015 in.

A J BREUGELMANS *New York, N.Y.*

SEVERE SERVICE indicates *MC* should use a high-grade bronze pump. He may be able to have interior of his present casing coated with neoprene, if the construction type permits it. Neoprene should stop erosion, just as it has on the impeller.

Many firms specializing in neoprene coatings will do the work in the field. *MC* should contact one or more of these, after he has obtained an OK from the manufacturer of the pump.

W H BRITT *Minetto, N. Y.*

TURN TO page 140 for your new problems from POWER readers on (1) Which is best oil...

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*

INSERT zinc plugs in suction-line openings to relieve the casing of the electrolytic action that sea water sets up. Have plugs long enough so they extend two or three inches into the water stream. Use at least one plug in suction pipe and one in the pump casing. Replace plugs after they become eroded.

Only other solution I know of is lining the casing with plastic. But for this job, special tools are needed.

A M DAMEROW *Elk River, Minn.*

USE ZINC PLATES in suction line and pump casing to reduce the effects of electrolysis on the pump. I work with pumps of this type every day in the week and know there is room for installation of the plates. Of course, zinc plugs that can be removed from outside the casing are easier to replace.

D P SCHOTT *Saginaw, Mich.*

BRONZE ROTOR in an iron casing can cause iron destruction near the impeller by graphitization. Attack on casing tends to protect the rotor. When casing becomes heavily graphitized, the graphite acts cathodically, and corrosion of the rotor results. Changing the impeller does not solve the problem because the new unit is also attacked.

Any welding-materials supplier can furnish sea-water corrosion-resistant metals for repair of the casing. An austenitic cast-iron rod, low in carbon, sulfur and phosphorus, is less expensive than a stainless-steel rod. It is resistant to sea-water corrosion.

L W FITZPATRICK *Jefferson City, Mo.*

BE SURE conduit around pump is well-grounded. If there's a possibility of stray leakage from electric circuits, use an insulating coupling between motor and pump shafts.

If *MC* wishes to continue using his present pump, he can protect it by supplying current to maintain the pump in an electro-negative state. But this complex problem should not be tackled without competent advice.

R T MORGAN *Lunenburg, N. S.*

SHOT-PEEN the impeller and casing with a heavy bronze mixture. This stops erosion of these parts.

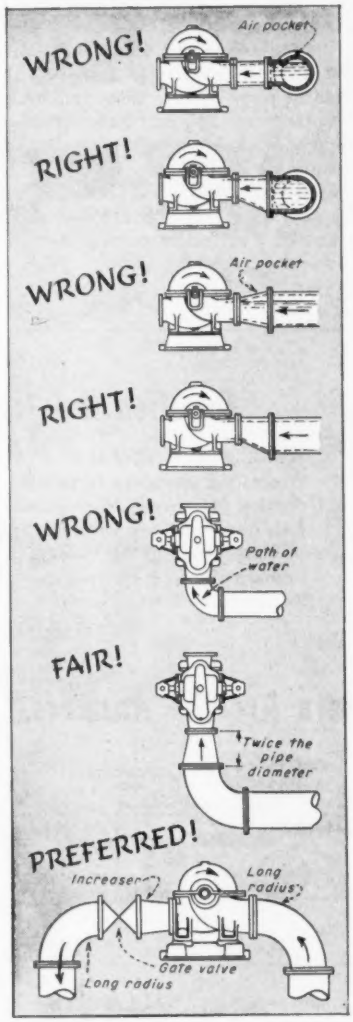
J M GORRIE *Euclid, Ohio*

TURBULENCE in sea-water suction line can increase impeller and casing corrosion. Sketches show right and wrong ways of piping suction line to pump. Keep suction-pipe velocity at 5 ft per sec, or less. See that changes in flow direction and pipe size are gradual, as sketches show.

Pumps made of nonferrous metals offer good resistance to sea-water corrosion. The Hydraulic Institute lists all-iron, bronze-fitted and all-bronze as common materials for pumps handling sea water or brine.

Coating the casing with neoprene prevents more corrosion but the job requires skilled mechanics. *MC's* best bet is to contact his pump manufacturer for the recommended materials to prevent corrosion spreading.

H B WAYNE *Brooklyn, N. Y.*



PLAY SAFE! Use only preferred hookup (lowest sketch) for suction piping

CHLORINE GAS from sea water causes *MC's* corrosion. Negative suction head of 6 ft causes gas to leave the water entering the pump. Best way to prevent gas leaving water is to lower the pump so it has a positive suction head at all times.

Use an independent clear-water sealing supply for shaft glands on pumps operating with a low discharge head or handling dirty water. Minimum sealing pressure should be 25 psi.

Lowering the pump so it has a positive suction head may involve piping and foundation changes, but it's my guess that the maintenance saved will soon repay the cost of moving the pump.

ART BELTON *Montreal, Canada*

RECOMMENDATIONS of the Hydraulic Institute should be followed when using pumps for salt water. If liquid handled is an electrolyte, any combination of dissimilar metals that may tend to promote galvanic action should be avoided if deterioration is to be held to a minimum. Where such couples exist, corrosion rate depends on nature of electrolyte, current concentration, temperature, velocity and the relative cathode-anode surface area.

While bronze fittings in a pump handling sea water tend to accelerate iron and steel corrosion, large bronze-fitted pumps are used for this service for economic reasons. Special alloy trims are sometimes used to reduce the galvanic reaction in standard-fitted pumps handling salt water. This improves the life of the iron casing, which is just what *MC* wishes to do.

Because of the many galvanic couples

...hookup? (2) How can we stop freezing in tank? Another chance to try your engineering ingenuity

Begins on page 136

set up by the graphite flakes and the metallic base, cast iron corrodes rapidly when in contact with sea water. But the products of corrosion, principally iron oxides, mat with the graphite and, if not mechanically dislodged, remain in place so the casing retains its original form. *MC* may have disturbed the mat when removing his impeller for coating with neoprene.

Formation of the mat is known as graphitization. As the layer thickens it acts as a protective coating and progressively decelerates attack. When a thickness of about $\frac{1}{8}$ in. has formed, further attack is slow.

The graphitized coating is relatively soft and under high or eddying velocities may be eroded away as rapidly as it forms. When this happens, the iron deteriorates rapidly. This explains why iron impellers fail more rapidly than the casing and why impellers are usually made of bronze. The bronze resists the attack, because the couple action with the graphitized surface is relatively low.

In large units, where the velocities are low, all-iron pumps may, under favorable conditions, stand up well enough in sea-water applications to justify their use. However, when replacement parts become necessary, the new ones become anodic and may deteriorate rapidly.

MC should take a cue from these facts. Perhaps two large, low-velocity pumps would serve his plant as well as four small, high-velocity units. Enlarging his suction line may be another answer to his problem.

C K Parker *New York, N. Y.*

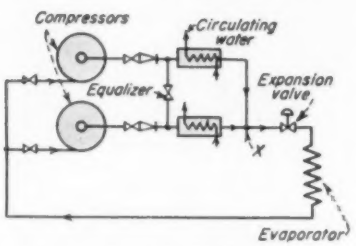
Question No. 2: What's Best Hookup for Refrigerating Units?

HERE ARE THE FACTS: We have two 5-ton refrigerating machines in parallel for creamery service. Suction pressure is 25 psi, discharge 170 psi. There's only one expansion valve for both machines.

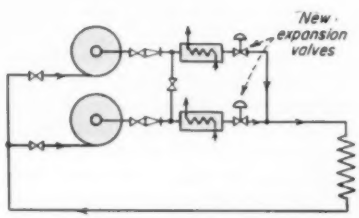
When either of the machines runs alone we are able to maintain the right suction and discharge pressures. But when both units are in use, the suction pressure drops to 15 psi no matter what the load may be.

Is change in suction pressure a result of using only one expansion valve? We have an equalizing line on the high-pressure side of each condenser, and the electric hookup is OK. What can we do to maintain a 25-psi suction pressure with both of our refrigerating machines running?—*EK, Sept Power*

Here Are the Answers



Present installation



Suggested setup

TWO EXPANSION VALVES are needed for *EK's* system to run properly. If he checks the capacity of his present valve he'll find that it is sufficient to handle only one compressor. Flow from the second compressor is restricted by the valve orifice, causing suction pressure to fall when two machines run.

First sketch shows present installation. One way to improve system operation is to increase the pipe size, beginning at point *X*. Valve size must also be made larger to accommodate full flow from the two compressors. New valve should be able to handle flow from one or both compressors at the same pressure ratio of 170/25 at either flow.

Second sketch shows how two expansion valves may be used, the discharge of each running to a common line. This hookup allows closer regulation than one having a single valve. Also, by using shutoff valves, one machine can be run while it or its expansion valve is down for maintenance.

A J Breugelmans *New York, N. Y.*

COMBINED TONNAGE appears to be about 40% greater than actually needed because suction pressure drops from 25 to 15 psi when second machine starts. Or the evaporator may be too small for the capacity required. It looks as though cooling needs were originally over-estimated or load was underestimated. Then a second machine was added in hopes of improving the situation.

If evaporator and refrigerating machines are properly sized, the expansion valve may be too small. If it is, replace it with two valves with equal-size orifices. Consult expansion-valve manufacturer for best hookup and control of the system. If one or both compressors short-cycle after installation of two expansion valves, a single-outlet expansion tank is needed in the suction line.

If tonnage is too great, try eliminating one water-cooled condenser. A 50% reduction in condenser surface would

(*Continued on page* 140)

For this month's two new questions from Power readers, turn to page 140

Wherever Drip, Splash or Squeeze-out Is a Problem

Use SUNTAC

Suntac Oils stay put, leave no gummy residue. They are ideal for lubricating gears, sprockets, chains, cables, couplings, linkages and bearings where throw-off must be avoided. Call your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. P-12

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Begins on page 136

cure the problem, but *EK* would have to experiment to find the exact results he could regularly expect. This suggestion is made without knowing what discharge pressure exists when both of the machines are running.

L L SANTORO *Chicago, Ill.*

THIS SYSTEM is obeying the fundamental laws of physics. With two compressors running, gas is removed from suction line at a rate faster than it is being supplied. As a result, suction pressure falls.

If *EK* has other cooling loads in his creamery he can add them to his present system so he uses more of the installed capacity. Expansion valve size must be checked to see that it is sufficient for the larger load. Perhaps a second valve will have to be installed.

Another alternative is to install a suction-pressure cutoff switch to stop one compressor when pressure falls below 25 psi. Use a selector switch in the circuit so compressor to be cut out can be alternated from day to day.

W H MILLER *Lancaster, Pa.*

LIQUID CARRYOVER to compressors causes knocks, low-suction temperature and frost on suction line. More evaporator surface is needed to reduce liquid carryover in a system the size of *EK's*. This is best done in a direct-expansion system by adding another evaporator.

From what *EK* says, an additional expansion valve, or a larger one, is also needed. If there is no liquid carryover, drop in suction pressure is caused by a starved evaporator. Greater valve orifice area will cure this by permitting higher flow rate through the valve.

I've known engineers who drilled or reamed the orifice of an expansion valve to increase flow. This procedure is not advisable, however, unless you have the manufacturer's OK. Otherwise, you might ruin a good valve.

Remember, any obstruction in liquid line like a plugged strainer, partially closed valve, etc, will cause suction pressure to fall. So check the line carefully before making any major changes in the system.

JAMES SMITHWICK *Washington, D. C.*

REPLACE the single expansion valve with one for each machine. Set each valve to maintain a suction pressure of 25 psi.

Two small valves usually cost less than one large valve for the two machines. Use of two valves permits shutting down one compressor while the other is being maintained. Greater flexibility is obtained, permitting the machines to run independently at the design load, or at the reduced load. This gives better efficiency.

H B WAYNE *Brooklyn, N. Y.*

DON'T GET MAD at an expansion valve —you'll regret it. It looks to me as though *EK* runs his machines at too high a speed for efficient operation. Check with compressor manufacturer to see what speed is recommended for these units. Then reduce speed, if necessary.

J M GORRIE *Euclid, Ohio*

USE a separate evaporator and expansion valve for each machine. This gives foolproof control and prevents freezing of creamery products. Use a high-low cutoff switch for each compressor.

Thermostatic expansion valves are better for these small units than manual valves because operation is automatic. If *EK's* machines are old, he might consider replacing them with new high-speed units.

A M PALMER *Brooklyn, N. Y.*

FIVE POSSIBLE CAUSES of *EK's* trouble are: (1) System is not fully charged. (2) Liquid-line strainer is clogged. (3) Expansion-valve power assembly has lost all or part of its charge. (4) Expansion valve is obstructed or too small to handle the capacity of both machines. (5) Pressure drop through evaporator is too great when both of the machines are running.

If I were *EK* I'd investigate these points first. If suction pressure is still too low, install a suction-pressure regulator ahead of each compressor.

H H LEVEE *Franklin Sq, N. Y.*

BEST SOLUTION is to control one compressor automatically by suction pressure so it cuts in at 25 psi and stops at a slightly lower pressure. This hookup saves power, besides giving better control.

Suction-pressure regulator set at 25 psi might do the trick for *EK*. It would help keep evaporator temperature at desired level when both of the compressors are running.

R T MORGAN *Lunenburg, N. S.*

YOUR NEW PROBLEMS FOR DECEMBER

1 Which Is Best Oil-Filter Hookup?

We're planning to install three 600-hp 4-cycle supercharged dual-fuel diesels in our municipal power plant. Engine manufacturer has given us our choice of lube-oil filter type and hookup. We'd like help from *Power* readers before making our decision.

Which type of hookup is best for this kind of engine—shunt or bypass? What pressure drop can we expect across the filter in each hookup? Can the same size filter be used for shunt as for a bypass installation?

Which kind of filtering medium is best for each type hookup? Does time between cleanings vary, assuming the engine produces the same quantity of solids with each type of filter hookup? Will savings in initial cost for one hookup be wiped out by increased engine maintenance or high cost of filter material replacement?—*AF*

2 How Can We Stop Freezing in Tank?

I'm chief engineer of a 2-year-old hotel building in one of the coldest areas in North America. Building is 16 stories high and has a 100,000-gal steel roof tank for storage of domestic and fire-protection water.

Last winter, during a severe cold spell, we had considerable trouble with ice in the tank and some of the piping to and from the tank. Though there is a steam heater fitted to tank, its capacity does not seem sufficient to prevent the water from freezing.

What's the best heating system for a tank of this size when outdoor temperatures may go as low as –60 F? How should heater be piped for best results? Where can insulation be best allied to an outdoor steel tank? Is there any type or grade of insulation that gives better results for this kind of service on steel tanks?—*NN*

Will you help readers who sent us problems? Extra pay for photos or sketches.

WHY BE

STYMIED

BY CARRYOVER and BLOWDOWN?

Impure steam and excessive blowdown are two problems that need not be tolerated by any power plant engineer, thanks to effective anti-foam agents.

Within recent years, the Betz organization has developed several anti-foam agents which have produced remarkable results both from a standpoint of better boiler operation as well as direct savings.

For instance, a southern chemical plant installed a new high pressure boiler and turbine to operate in conjunction with the existing lower pressure boilers and turbines. To minimize silica vaporization, the condensate of all boilers was returned to the high pressure system. As a result, difficulties were encountered in the operation of the low pressure system—high boiler water solids developed causing severe carryover, and the low pressure turbines eroded seriously.

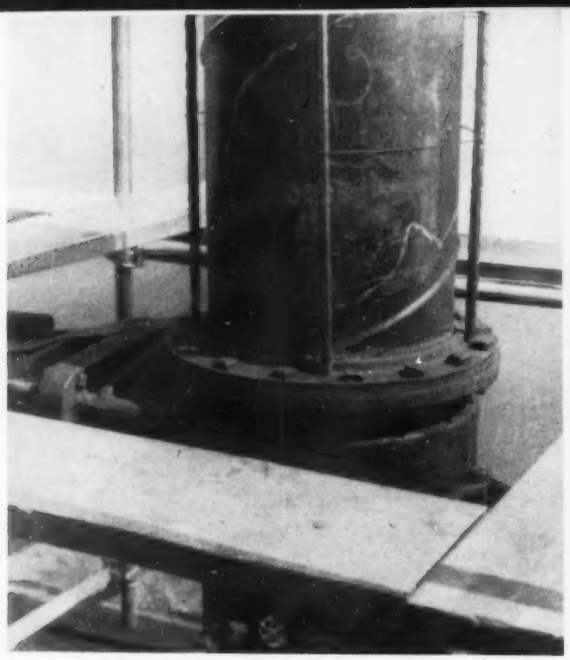
After analysis, Betz Engineers recommended the application of anti-foam agents which *immediately* remedied this carryover condition. The solids content of the steam was reduced to 2 ppm at high boiler ratings without any increase in blowdown.

The positive control of carryover and boiler blowdown is just *one* of the *many* services offered by the Betz Organization. Let a Betz Engineer explain to you how our *complete* engineering guidance can help you solve all your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

For the complete story on carryover and blowdown control through the use of anti-foam agents, write for Technical Paper No. 115.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS



Here's the Way to Give Your Corroded Piping a New Lease on Life

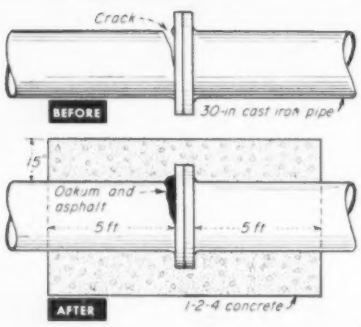
REINFORCING RODS are placed, and held with wire. Then they are covered with chicken wire to hold the concrete together

FINISHED JOB is a pipe that's well-covered over corroded sections and repaired in place without taking anything apart

HOW TO

Save Cracked Piping With Concrete

By **E E SMITH**, *Clarks Summit, Pa.*



Cast Iron Repaired

UNDERGROUND circulating-water line is cracked in several places. Oakum and asphalt is calked into cracks, then pipe is reinforced and covered with concrete

► SKETCH SHOWS how we repaired a 30-inch cast-iron flanged pipeline. Broken section was part of a circulating-water line used on a 20,000-sq-ft surface condenser. Break was about 10 ft below grade level, and inside a building. It would have been very difficult to do much excavating to remove cracked section for replacement.

Best delivery we could get for a new section of pipe was three months. This put us on the spot, as our station generating capacity was lowered about 15,000 kva because of circulating-water line. Normal operating pressure in line is about 25 psi.

As shown, pipe cracked open at flange corner and the break extended about half-way around pipe. Quickest way to repair it would have been to pour a concrete block around the break for several feet on each side. We calked oakum into the cracked opening, just tight enough to make it stay in place. We then spread a light coat of asphalt roofing paint over the oakum. Next, heavy strips of canvas, about six inches wide, were wrapped around break and bound with copper-wire lashing.

The asphalt coat was applied to the canvas lightly after it was lashed. We then built forms around the pipe, about five feet from each side of break and high enough to give 15-in. thickness on top of a fully covered pipe all around. About 7½ yards of a 1-2-4 concrete mixture were used in the pour.

Repair was made 13 years ago and we have never seen signs of leakage. Photographs show some other applications of concrete around old and thin pipelines, which eventually left a concrete pipeline when the old pipeline inside the concrete had worn out.

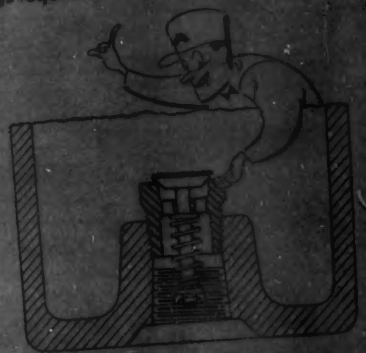
How Armstrong Traps Save you Money

Choice of body styles saves money on installation costs.

Hardened, ground and lapped valve and seat; stainless steel mechanism resists wear and corrosion—saves money on maintenance.

Two phase leverage means higher capacity in a smaller trap. Armstrong traps have optimum relation between leverage, valve travel, bucket weight, capacity and overall size.

This internal check valve saves labor and fittings required to install regular check valve.



This trap with built-in strainer costs less than separate trap and strainer—requires less labor and fittings to install.

Get the full facts on money-saving Armstrong traps. Send for free Catalog J. Clip and mail coupon today.

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan

Gentlemen: Please send me a free copy of Catalog J, The Armstrong Steam Trap Book.

Name _____

Position _____

Co. Name _____

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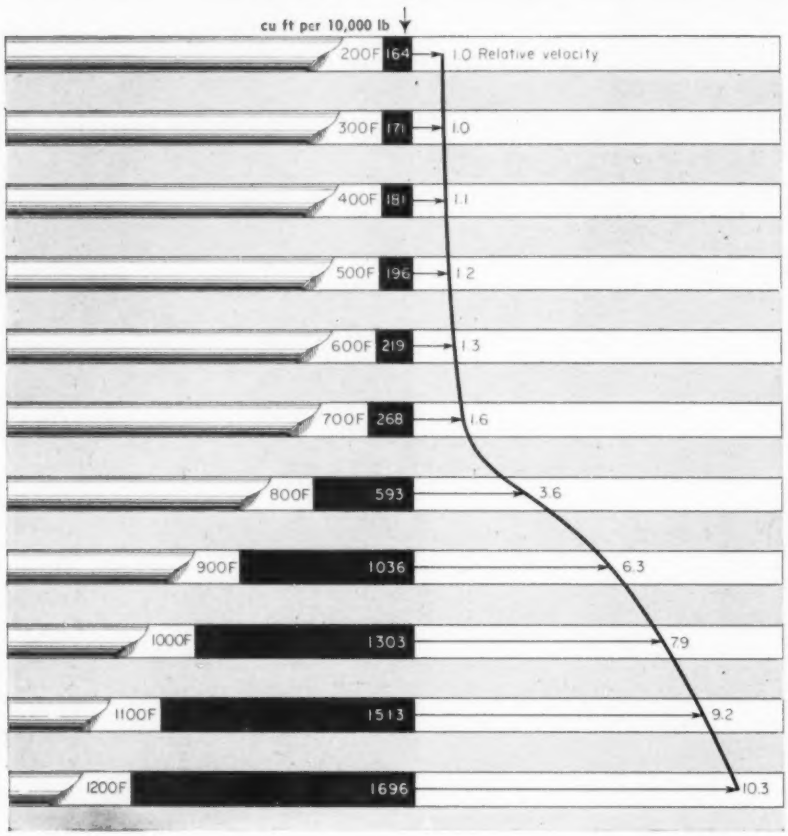
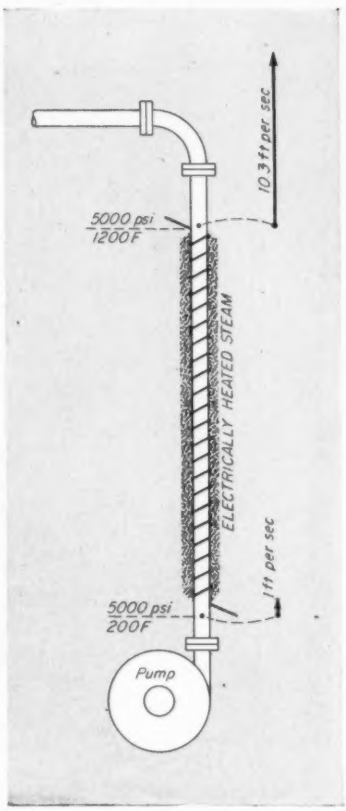
ARMSTRONG STEAM TRAPS

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH





The ABC of Superpressure—3

SKETCH AT RIGHT shows an imaginary laboratory setup to demonstrate the generation of superpressure steam. Nothing could be simpler.

Remember that at any pressure above the critical (3206 psi absolute) water passes quietly and gradually into "steam" without any boiling or bubbling. In fact, strictly speaking, it is hard to say when it stops being water and when it becomes steam.

Here the laboratory steam generator is nothing but a vertical tube wound with an electric heating coil, which in turn is covered with heat insulation. Feedwater enters at the bottom at 5000 psi and 200 F.

For simplicity, pressure drop is taken as zero, so fluid leaves the top at 5000 psi. Rate of flow and electrical input are controlled and maintained to give 1200 F at outlet. Here we have a complete "plant" to produce steam at 5000 psi and 1200 F.

Fundamentally, what happens in this elementary experiment is just what happens in an actual superpressure steam generator, except that the heat would there be supplied by burning fuel, and the feedwater temperature would be far above 200 F.

In the chart at left, note how rising temperature expands 10,000 lb of feedwater from 164 cu ft at 200 F to 1696 cu ft of steam at 1200 F. This is a ratio of 10.3 to 1, expansion of about 100%.

With constant tube diameter this means that the exit steam flows 10.3 times as fast as the inlet feedwater.

Left side of the chart shows the very fast pickup in volume between 700 F and 900 F. If the pressure were somewhat lower—say, 4000 or 3500 psi—this sudden expansion in the general region of the critical temperature would be even more noticeable.

To sum up, a superpressure boiler needs no drum. You simply pump water into one end of a long tube (or group of tubes in parallel) and take steam out at the other end. You supply the necessary heat to the tube by radiation and convection. The steam is made without boiling. *(To be continued)*

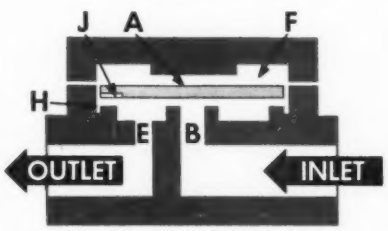
SARCO
Thermodynamic
STEAM TRAP

ACTUAL SIZE

this new trap virtually eliminates maintenance - won't wear out

SOLID STAINLESS STEEL DISC ACTS AS VALVE HEAD

HERE'S HOW IT WORKS!



Air and or condensate raise valve seat disc A, discharge thru E. When steam follows, greater velocity causes it to strike body at H thus building up pressure in chamber F. This causes disc to seat, closing tube B. As pressure in F decreases by condensation and leakage thru slot J, pressure in tube B raises disc and cycle is repeated.

The Sarco Thermodynamic Trap has proved successful on steam mains and separators; headers and soot blower pipes; engine and turbine stop valves, separators and casing drains; alternate heating and cooling applications.

A solid stainless steel disc—practically indestructible—is the only moving part!

Most striking feature of the Sarco *Thermodynamic* Trap is its simple maintenance-free design. There's only one moving part – a solid stainless steel disc that practically lasts forever. There are no other moving parts to wear out or cause trouble.

Condensate, air and steam act directly on the disc valve which opens to discharge condensate and air – snaps shut to contain steam. There are no mechanical devices required to operate valve (see diagram at left). That means practically endless trouble-free operation.

Other advantages: small size, easy installation, not affected by shock or vibration, immunity to corrosive elements with all wearing parts stainless steel, same valve head and seat for all pressures to 600 psi and temperatures to 950° F.

Check these advantages to your own satisfaction at absolutely no cost. We'll send you a trap for free trial. All you do is fill out the coupon and mail it in.

SARCO COMPANY, Inc.
Empire State Building, New York 1, N.Y.

MAIL COUPON TODAY FOR FREE TRIAL

Sarco Company, Inc., Empire State Bldg., New York 1, N.Y.
Gentlemen: Please send me a Sarco Thermodynamic Trap for free trial, requirements as checked.
Size: ½"... ¾"... 1"... Operating Pressure:.....psi

For installation on.....

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

"What'ya think they're made of, rubber?" muttered the chief to himself.

Marmaduke's Rubber Condenser Tubes

► "BILGEWATER ON ENGINEERS WITH STRAIT-JACKET MINDS!" roared Marmaduke Surfaceblow as I barged into O'Houlihan's Machine Shop and Engine Works last week. "If you don't have imagination and a natural savvy of machinery, then steer clear of power plants."

I had started to climb the rickety stairs to the old consulting engineer's office when I heard that familiar foghorn voice above the machine shop's slapping and squeeking leather belts. A letter from A W Shepherd of San Diego, California, had brought me here looking for some information.

Entering the machine shop, I saw Marmy surrounded by O'Houlihan, Pete Jacobs, the foreman, and some machinists in greasy overalls. O'Houlihan was checking a blueprint and measuring a large half-machined casting. Then he shook his bald head sadly—evidently the job had been spoiled. But Marmaduke kept sounding off, so I walked inside and listened.

"Here's what I mean," bellowed Marmy, paying no attention to O'Houlihan's headache. "Back in 1916 I was maintenance foreman at the Pacific Gas & Electric Co in San Francisco. We had several large condensers of 6000 tubes apiece. About 400 tubes had been leaking in one condenser, so they were plugged from both ends with tapered brass plugs. My job was to retube that condenser.

"Chief engineer Jake Drummerhauser was on edge because the plant couldn't supply enough power as it was, so he wanted that retubing job done in record time. And he made it clear that nothing was to prevent smooth sailing once the new tubes arrived and we shut down.

"I doped out a schedule and drilled my men so every move would count when we finally got the new tubes. Each man practiced a job on a small scrap condenser until he could do his part with his eyes closed. After several weeks the long boxes arrived. I had them stowed near the condenser so they'd be handy.

"Jake gave me the green light a few days later. We were to shut down and start retubing on Sunday morning. We'd work around the clock until that condenser was buttoned up. To make things interesting, I promised my boys a clam bake, with all the beer they could drink, if we made knots.

"Soon as the condenser was cut out my gang heaved to like an old time Navy bucket brigade. They spun those one-inch nuts off the water-box cover studs so fast the threads smoked. Nuts were dropping to the floor-plates like a hailstorm rounding Cape Horn. In no time we hoisted the water box cover out of the way and started reaming out the old tubes.

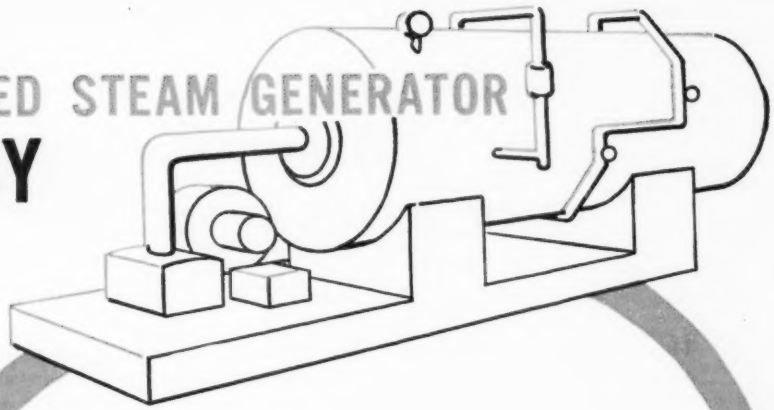
"My plan was to have each new tube guided in by following an old tube as we pulled it out. The new tubes were 1-in. Admiralty bronze, 20 ft long. But the first new tube didn't quite reach the opposite tube sheet. That scuttled the works.

" 'Maybe she's a short one that got into the shipment,' someone reasoned. But the next tube didn't reach either. A quick check showed everyone of those 6000 tubes 3 inches short.

(*Continued on page* 222)

Ideal Combination

FOR TOP SELF-CONTAINED STEAM GENERATOR EFFICIENCY



1

Nalco WATER TREATMENT

SCALE AND CORROSION PREVENTION

With a Nalco Service Policy and Nalco Chemicals to fit your water treatment requirements, you can keep your self-contained boilers operating indefinitely at top efficiency — without any of the costly difficulties caused by scale and corrosion. This part of the Nalco System was designed expressly to provide small boiler users with the same complete water treatment services enjoyed by thousands of the country's largest power plants. A new 4-page bulletin gives complete details on The Nalco System as applied to the modern self-contained boiler. Your copy will be sent promptly, without obligation.

Write for Bulletin 49

2

Nalco SR-155 FUEL OIL ADDITIVE

FUEL SAVING . . . CLEAN BURNERS

Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM • Serving Industry through Practical Applied Science

JENKINS PRACTICAL PIPING LAYOUTS 71

How to plan

PIPING CONNECTIONS FOR A NON-FREEZE COOLING TOWER

The non-freeze cooling tower illustrated here is one of several types in use for hotels, institutions, supermarkets, and shopping centers where uninterrupted refrigeration is a round-the-clock operating requirement. This type offers the advantage of a dependable supply of cooling water at low cost, and conforms with water conservation regulations now in effect in many locations.

Cooling tower and compressors must operate on the same schedule in any continuous refrigeration system. The tower must perform its function even when the temperature is below freezing. For this reason, the water used in this system is stored in a vented or open tank located in a heated space, rather than in the conventional pan under the exposed tower.

When freezing weather occurs, an anti-freeze solenoid valve, actuated by a temperature-sensitive device, opens to drain all water from lines exposed to outside temperatures. The automatic 3-way solenoid valve, also temperature actuated, permits the water to bypass the cooling tower under freezing conditions, or when it becomes too warm due to fan failure or overload in the storage tank. Under the latter condition, the automatic overheat dump valve would also open. The subsequent drop of the water level in the storage tank causes the float valve to open and admit city water to make up the deficiency. Thus, in an emergency, city water would be used for cooling.

The Jenkins Solder End Valves recommended for various control points in this system are made for use with Types K, L, and M copper tubing. Designed by Jenkins specialists, they have the extra durability that assures life-time economy and trouble-free performance even where valve usage is most severe. Their liberally dimensioned body castings will withstand the heat of soldering without danger of distortion or warping of seats.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run*. Jenkins Bros., 100 Park Ave., New York 17. Sold through leading Industrial Distributors everywhere.

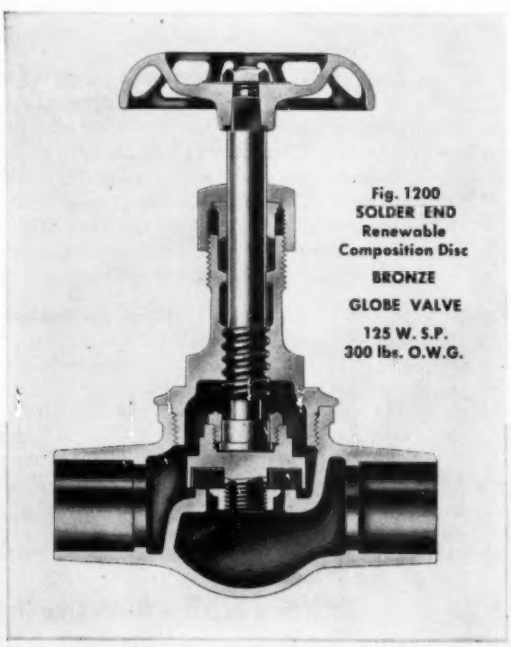
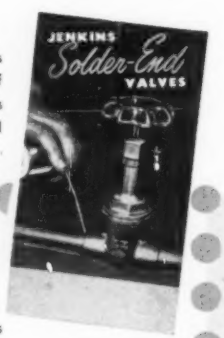


Fig. 1200
SOLDER END
Renewable
Composition Disc
BRONZE
GLOBE VALVE
125 W. S.P.
300 lbs. O.W.G.

SEND FOR THIS FOLDER. It illustrates and describes the complete line of Jenkins Solder-End Valves, and gives principal dimensions. Fill out and mail the coupon today.



JENKINS BROS., 100 Park Ave.
New York 17, N. Y.

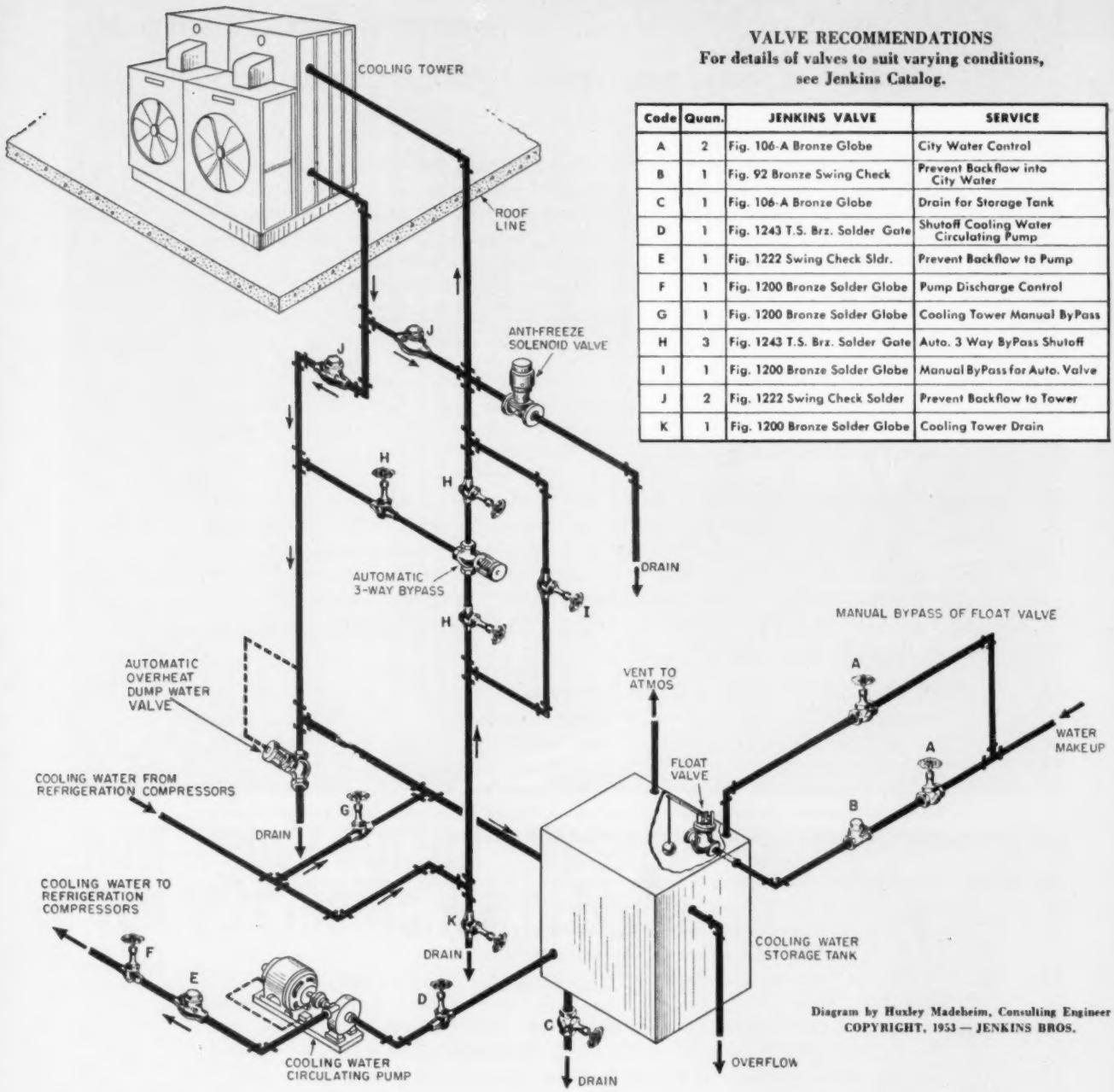
Please send folder on Solder-End Valves

Name .....

Company .....

Address .....

PIPING CONNECTIONS FOR A NON-FREEZE COOLING TOWER



VALVE RECOMMENDATIONS

For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	JENKINS VALVE	SERVICE
A	2	Fig. 106-A Bronze Globe	City Water Control
B	1	Fig. 92 Bronze Swing Check	Prevent Backflow into City Water
C	1	Fig. 106-A Bronze Globe	Drain for Storage Tank
D	1	Fig. 1243 T.S. Brz. Solder Gate	Shutoff Cooling Water Circulating Pump
E	1	Fig. 1222 Swing Check Sldr.	Prevent Backflow to Pump
F	1	Fig. 1200 Bronze Solder Globe	Pump Discharge Control
G	1	Fig. 1200 Bronze Solder Globe	Cooling Tower Manual ByPass
H	3	Fig. 1243 T.S. Brz. Solder Gate	Auto. 3 Way ByPass Shutoff
I	1	Fig. 1200 Bronze Solder Globe	Manual ByPass for Auto. Valve
J	2	Fig. 1222 Swing Check Solder	Prevent Backflow to Tower
K	1	Fig. 1200 Bronze Solder Globe	Cooling Tower Drain

Diagram by Huxley Madeheim, Consulting Engineer

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Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A **Use the right type valve for the service**

B **Place valves correctly in the line**

C **Choose Jenkins for lifetime economy**

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK

Jenkins Bros

Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

Supercritical-pressure studies emphasize efficiency gains. For example, Westinghouse engineers report that a 200,000-kw turbine-generator, to operate at 5000 psi, 1200 F and two reheats, would yield a 5 to 6% gain in over-all plant efficiency compared with a conventional unit (2000 psi, 1100 F). If this looks small, apply it to the roughly half-million tons of coal such a plant would burn yearly.

And don't overlook the big economic factor hidden by concentration on heat-rate comparisons – drastic potential savings in investment cost from sharply shrinking size of nearly all major equipment elements and structures.

Electrical election promises are no better than any others, according to UP. Seems that Mayor Giovanni Morini of Verona, Italy, promised power for one of the suburbs. When he didn't deliver, a landowner filed suit. Court dismissed the case: The mayor wasn't bound by promises made as a private citizen.

Atomic-warfare plans seem to be coming down to earth after stratospheric jitters occasioned by Russian H-bomb claims. No one disputes the seriousness of the situation or the need for far-reaching re-examination of defense policies. Immediate steps, however, are these: (1) Up to $1 billion more for interceptor aircraft, warning systems, etc. (2) More emphasis, within current budgets, on research and development, particularly of guided missiles. (3) Greater encouragement to industry to disperse facilities and take protective steps.

Atom-bomb protection – and a substantial measure is possible – will get increasing attention in months ahead. Detailed surveys of essential facilities are well under way by Dept. of Commerce and other agencies; industry advisory committees will be asked to help develop protective measures for specific situations.

To encourage building of bomb shelters, blast walls and other protective structures, in existing plants as well as new ones, Office of Defense Mobilization allows a 5-yr. fast tax writeoff on 100% of cost of such measures.

Footnote to jingle printed here last month comes from J P Warren, power consultant with Dow Chemical Co, Freeport, Texas. Down there, they say:

The man who knows how will always have a job
The man who knows why will supervise him
But the man who knows how and why will own the plant!

Expansion and modernization of American industry will continue high in 1954, just about 4% behind 1953's record-setting capital investment. That's the gist of a preliminary survey of plans for capital spending just made by McGraw-Hill's Dept of Economics. Good-news note: electric-power industry is one of several expecting to spend as much (or more) in 1954 as in 1953.

Economy drives, now much in vogue as a result of "recession" talk, always remind me of a railroad chief of motive power who harped on economy day and night. Examining a locomotive-engineer candidate one day, he said, "You're heading into a single-track curve when you see another headlight shining 'round the bend. What would you do?" The answer bore testimony to his preaching: "I'd slam on the brakes, shut off the lubricator, and jump!"

Lou Lowley

NEW

Periodically, new motor-driven washer completely cleans cell plates—re-applies adhesive—by "push-button" operation. Moving nozzles clean thoroughly to full cell depth.

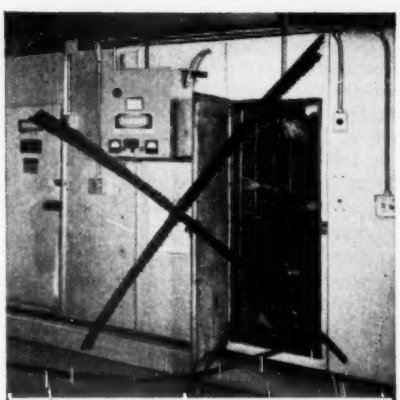
NOW—"PUSH-BUTTON" WASHING FOR ELECTRONIC AIR CLEANER

Now, a new, low-cost, automatic PRECIPITRON® washer cuts maintenance costs and eliminates unpleasant inside-the-duct washing of cells.

This unique device features moving nozzles, making PRECIPITRON the easiest electronic air cleaner to service. After thoroughly cleaning the plates, the washer reapplies adhesive. Entire operation is under "push-button" control. Laboratory and field tests have proved that moving-nozzle washing is a "must" for proper cleaning.

Type PX PRECIPITRON, the electronic air cleaner, traps microscopic airborne particles of dirt, dust, grime and pollen which would pass through conventional filters. It fits into any heating, ventilating or air conditioning ductwork.

Learn how PRECIPITRON will keep the air in your building dirt-free at negligible cost. Call your local Westinghouse-Sturtevant office, or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.



Maintenance men no longer need to enter enclosure to clean PRECIPITRON. New "push-button" feature does away with hot, wet tasks.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE ... IF IT'S Westinghouse

J-80231

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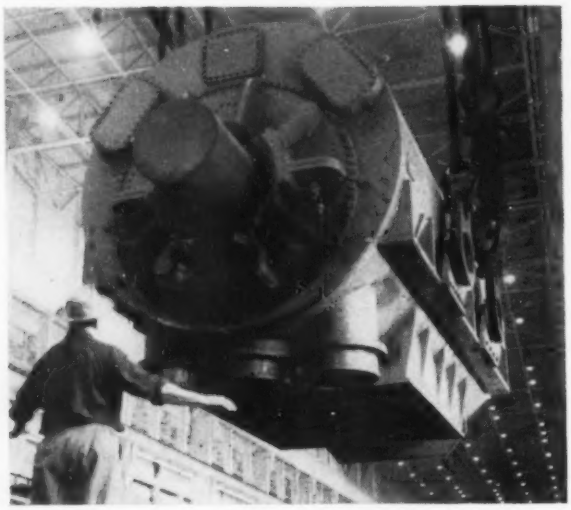
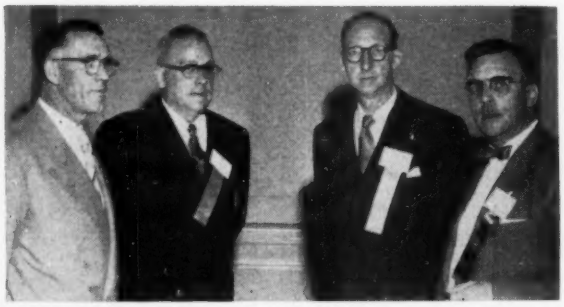
TECHNICAL BRIEFS_____154
PLANT EQUIPMENT NEWS_____158
NEW FREE BULLETINS_____167





NEW OFFICERS for Canada's Institute of Power Engineers: *left to right*, George Gibson, vice-president; Charles E Baker, president; William G Child, general secretary; Fred Bignell, vice-president. (For story of annual convention, see p 256)

←
WORLD'S first inner-cooled generator, built by Westinghouse Electric Corp, goes to Niagara Mohawk Power Co. Unit is rated at 100,000 kw yet, through redesigned cooling system, is only slightly larger than average 40,000-kw machine

U. S. Plans Broad Atomic Energy Program

GENERAL ELECTRIC CO has taken a double-barreled shot at the job of enlarging the scope of today's atomic energy applications. The company has offered the Atomic Energy Commission a proposal to build a large-capacity power reactor, at government expense, at the Hanford Works in Washington state.

Since operating temperatures of present reactors are entirely too low for economical power production, this installation would require an entirely new plant. No details are available on power capacity, operating temperature and other technical information, but GE states that the project would be economical.

Aim of this new installation would be to alleviate the power drain that the Hanford Works have been making on the Northwest hydro system. GE says the project would produce enough power to carry the Hanford Works itself and would also supply a surplus for supplementing regional sources.

GE is also planning to test-operate a new reactor power plant for submarines. Chicago Bridge and Iron Co has built a large steel sphere at Knolls Atomic Power Laboratory's West Milton, N. Y. site. This 3850-ton structure, 225-ft in diameter and higher than an 18-story building, will house the complete submarine during reactor tests.

WESTINGHOUSE ELECTRIC CORP has contracted with the Atomic Energy Commission to construct the first full-scale atomic energy plant for peaceful use, a plant that will produce a minimum of 60,000 kw and will cost "tens of millions of dollars."

Rear Admiral Hyman G Rickover, atomic reactor expert of the United States Navy, will be in charge of the project. Although still in the planning stage, AEC hopes to have the plant erected and in operation within three to four years. Tentative sites are Oak Ridge, Tenn.; Paducah, Ky., and Portsmouth, Ohio.

Early this year AEC submitted to the National Security Council a statement of policy on the development of nuclear power. Despite differences in political and economic opinions among the men of the Commission, unanimity was reached—in the only full informed quarter in the country—concerning the important subject of nuclear power development.

The nuclear power development race now seems to have split into two separate contests: (1) the arms race, including the production of bombs, missiles, submarine power plants and other weapons, and (2) the industrial power race. Thomas E Murray, AEC Commissioner, emphasized the importance of considering both parts of this race.

Speaking of the recent news about *thermonuclear* (H-bomb) demonstrations in Soviet Russia, Murray said, "This recent USSR accomplishment, great as we must admit it to be, is less dangerous today to the free world's hopes for the end of Godless tyranny than would have been the case if the Soviets had announced that they had been successfully operating a practical industrial nuclear power plant—and were offering foreign nations nuclear power technology in exchange for uranium, coupled with other favorable economic and political agreements.

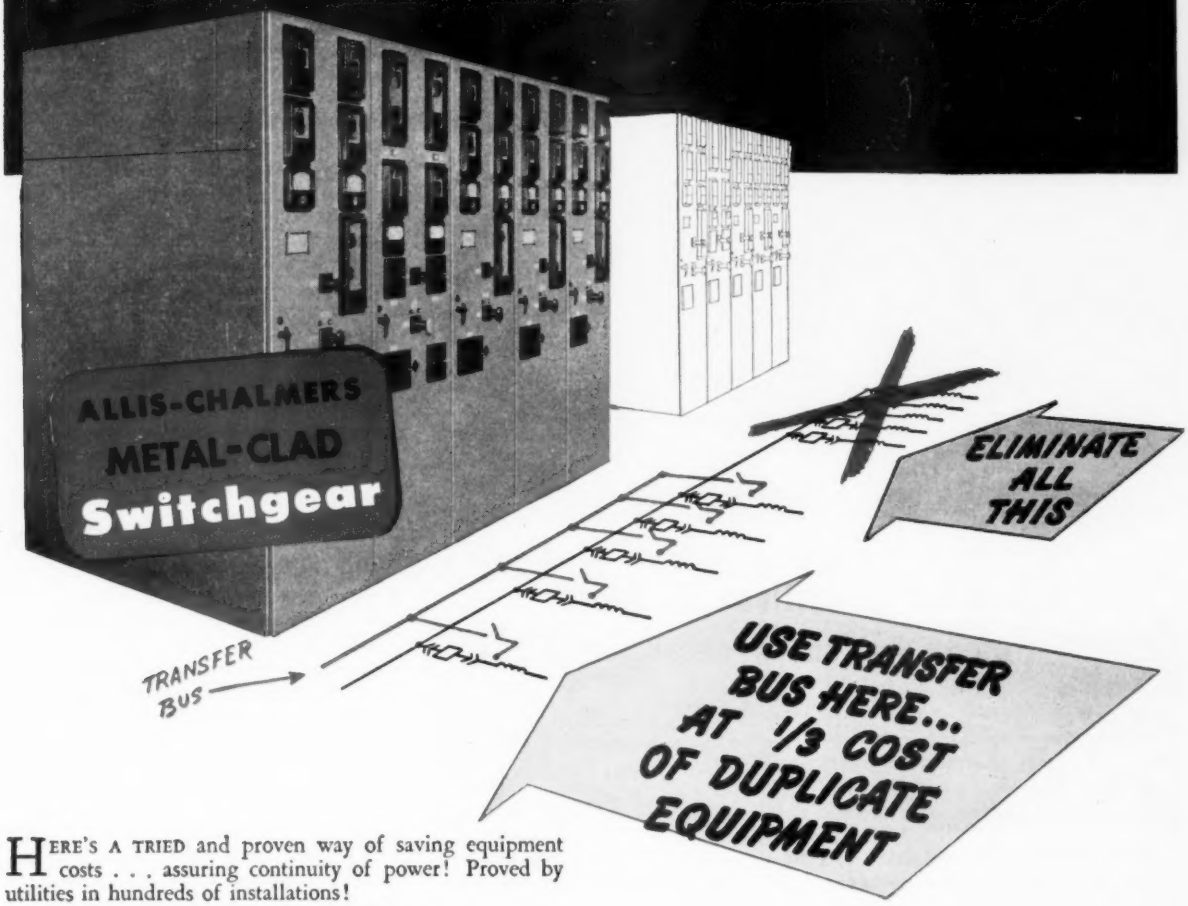
"It is no secret that our atomic weapons program depends upon the receipt of substantial quantities of uranium from foreign nations. These friendly nations, I think, are motivated mainly by two beliefs. They believe in the military protection afforded by our atomic weapon potential. But we sometimes are inclined to forget that they also are betting on our great record of success in solving industrial and technological problems. They are banking on United States know-how and United States good faith to help them build their nuclear power plants of the future.

"I believe that unless we embark on

(*Continued on page* 258)

For coming events see page 262

Why Buy Duplicate Switchgear to Assure Power Continuity?



HERE'S A TRIED and proven way of saving equipment costs . . . assuring continuity of power! Proved by utilities in hundreds of installations!

What is a Transfer Bus?

It's simply a by-pass bus circuit that parallels the main switchgear bus. A switching means is provided so that loads can be transferred to the transfer bus. It's a standby in case anything happens to the main bus. Also, makes it possible to withdraw and maintain circuit breakers, or inspect main bus without power stoppage.

What are Other Advantages?

1. Saves Cost. Transfer bus costs about ⅓ as much as the additional equipment needed to provide duplicate switchgear to do this same job.
2. Cuts Space in Half. Allis-Chalmers supplies transfer bus in same cubicle as switchgear without adding cubicles. Thus an Allis-Chalmers installation cuts space one-half.

In addition, you can insure against failure of power source by providing a double end feed with the one set of switchgear and be as sure of power supply as if you had duplicate switchgear.

Depending on the job you want to do, there are many arrangements that Allis-Chalmers can provide. In many cases, the engineering has already been done.

Ask an Allis-Chalmers engineer about transfer bus arrangements and what they can mean to your plant in savings and service. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3731

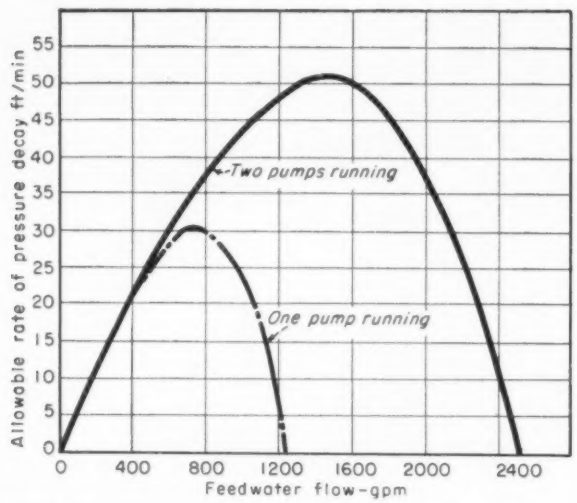
ALLIS-CHALMERS

First in the U. S. with Metal-Clad Switchgear

TECHNICAL BRIEFS

Latest engineering developments for busy power men

9 Digests for you on:
PUMPS
FUELS & FIRING
STATION DESIGN
ELECTRICITY



ALLOWABLE RATE of decay starts at zero at no flow, maximizes at approximately 700 gpm per pump and falls back to zero at 1250 gpm

Transient Conditions in Boiler Feed Pumps Attract Greater Attention

Centrifugal Boiler Feed Pumps Under Transient Operating Conditions. *By Igor J Karassik, Worthington Pump Corp, G H Bosworth, Bechtel Corp, and W D Elston, Pacific Gas and Electric Corp.*

The study of transient conditions in a steam power plant and of their effect on the centrifugal boiler feed pumps assumes the characteristics of a mopping-up operation. For years we have been developing power plants to operate at ever increasing steam pressures and temperatures to improve overall thermal efficiencies. It follows, therefore, that the problems introduced by transient conditions have grown in complexity and severity with time. Yet it has been only recently that much concern—or even interest—has been given to these problems.

The authors' present paper supplements the theories presented earlier with experimental data, develops a simplified method of evaluating the relative safety of a given installation and enlarges the scope of the field covered by including an anaylsis of problems which may arise in closed feedwater cycles. In addition, problems akin to those presented by transient conditions and arising from the use of common spare pumps in adjoining units—in either open or closed cycles—are included in the scope of this paper.

These problems for open cycles subdivide into two groups, namely, problems arising from an interruption or reduction in turbine load and problems caused by sudden increases in this load. Here is how the authors approach these problems.

The effect of a sudden drop in electrical load is for the turbine governor to reduce the inlet steam flow so as to maintain the proper relation to the generated power. The consequence of this reduction is a proportionate pressure reduction at all of the successive stages of the turbine, including the bleed stage supplying steam to the direct contact heater.

It is possible during this period that the NPSH (net positive suction head) available for the boiler feed pump may be reduced seriously because of the changing relationship between the decaying heater pressure, above, and the feedwater temperature at the suction end of the pump. The magnitude and duration of this reduction will vary according to the load drop that is experienced and will depend on a number of factors peculiar to each installation.

The allowable rate of decay starts at zero at no flow (because the residence time is infinite), rises to a maximum somewhere in the vicinity of 700 gpm per pump for the example case the authors pick and falls back to zero at 1250 gpm, where the available NPSH exactly balances the required NPSH. We must remember, however, that operation of boiler feed pumps at abnormally low flows is prevented by automatic controls and that 1250 gpm per pump is greatly in excess of the maximum feedwater flow demand for the unit the authors have under consideration. Thus, if we assume that the minimum permissible flow without recirculation is 125 gpm, the allowable pressure decay rate at low flows will be 10.5 feet per minute, or approximately 4.4 psi per minute. It should be considered that under low load operation a single pump may be running. Under these conditions, the residence time for any flow is effectively doubled and therefore the allowable rate of pressure decay shown on graph is approximately halved. Since such a situation may increase the danger of operation, it follows that, for a rigorous analysis of an installation where more than one pump is installed for normal operation, the allowable rate of pressure decay must be determined for single pump operation as well as for all pumps on the line.

The assumptions concerning the action of the controls involved are subject to wide interpretation. For instance, the action of the feedwater regulator makes it difficult to predict how soon after the load drop the feedwater flow to the boiler will become stabilized with relation to the turbine throttle flow. While the majority of large steam power plant installations are provided with three-element feedwater control, there are variations as to the manner in which those controls are adjusted. In general, the feedwater input is regulated to parallel closely steam output, but the control is sometimes adjusted to vary the boiler water level with the load as a precaution against the effects of "swell" and "shrinkage." Thus, while the water flow will go down with steam flow, the rate of drop may not be quite as fast as that of the steam flow. In addition, the transient condition problems are just as likely to occur in installations

(*Continued on page* 156)

Johns-Manville Insulations save industry a billion dollars in fuel every year!

Reduce your fuel costs and build better furnace linings with JM-3000 INSULATING FIRE BRICK

HERE'S THE ONLY insulating fire brick that withstands a full 3000F. It's highly efficient both as an exposed refractory lining or as back-up insulation. And JM-3000 is only one of six types of Johns-Manville Insulating Fire Brick made for these applications. All provide long-life insulation. All are light in weight, have low conductivity, high structural strength. These properties permit thinner furnace walls—yet you can achieve important fuel savings and increased production, because J-M Insulating Fire Brick assures quick furnace response.

Sil-O-Cel* Insulating Brick is another outstanding J-M fuel-saver . . . a high load-bearing brick for back-up insulation behind refractory linings. It comes in three types, for service through 2500F—makes it possible to reduce the necessary thickness of refractory linings as much as one-third.

Save fuel with J-M Hydraulic Setting Refractories

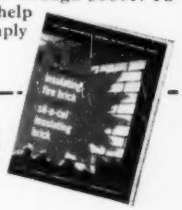
Johns-Manville refractories meet every need for castable, troweling and gunning applications for temperatures through 3000F. *Firecrete** is used to cast special shapes of all kinds. It is ready for use within 24 hours, has negligible shrinkage and high resistance to spalling. *Blazecrete** is used to build and repair furnace linings. When gunned, it adheres readily with a minimum of rebound loss. When slap-troweled, it eliminates laborious ramming and tamping.

Save Fuel with J-M Aggregates and Fills

These lightweight insulations are used as fills to conserve heat in irregular spaces where other forms of insulations cannot be economically applied. They are also used as aggregates for mixing with other materials to form insulating refractory concrete.

*Reg. U. S. Pat. Off.

Send for your free copy! This new booklet IN-115A gives full details about J-M insulating materials for service through 3000F. To find out how they can help cut your fuel costs, simply mail coupon.



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City & Zone_____ State_____

Begins on page 154

provided with a single element (water level) feedwater regulator.

Of all the factors enumerated, the most disturbing from the point of view of presenting calculations to determine the available NPSH under transient conditions is the behavior of the feedwater flow during that period of time. Any assumptions of the results of a load drop upon the immediate behavior of the feedwater flow are, therefore, somewhat hazardous. It would be desirable, therefore, if not to eliminate the need for these assumptions entirely, at least to postpone them. If, instead of determining the *actual* pressure decay rate in feet per minute for one given flow, we were to express this decay rate in terms of the volume pumped for the entire range of pump flows, we would be in the position to compare this rate with the allowable decay rate similarly expressed and establish the maximum flow for any given load drop below which the *allowable* rate exceeds the *actual* and below which the installation is always safe.

This process is, of course, simple for the *allowable* decay rate. In effect, if we divide dP/dt (*allowable* rate of decay in feet per minute) by dq/dt (pump flow in gallons per minute) we obtain a value of dP/dq which represents the *allowable* pressure decay in feet per gallon pumped. The results of these calculations for the installation described are shown graphically.

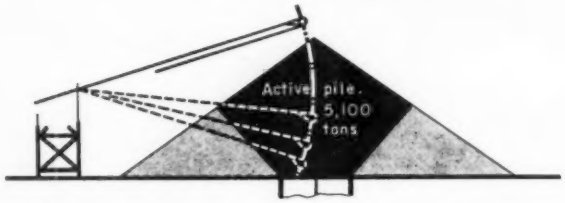
The authors then carry on in this manner to discuss other problems for open cycle and closed cycle feedwater operation as well. *ASME Paper, No. 53-F-32.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Society of Mechanical Engineers, fall meeting, Oct 5-7, Sheraton Hotel, Rochester, N. Y. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

Association of Iron and Steel Engineers, annual convention, Sept 28-30, William Penn Hotel, Pittsburgh, Pa. Identified by initials AISE and available from T J Ess, secy, AISE, Empire Bldg, Pittsburgh, Pa.



YARD COAL STORAGE consists of inactive and active volumes. Shaded portion of diagram shows inactive volume of 16,000 tons

Improved Controls Reduce Coal Handling Costs

Coal Handling Facilities with Automatic Remote Control Features.
By H C Schweikart, Gilbert Assoc.

Coal handling facilities ranging in cost from $5.00 to $20.00 per installed kw and averaging about 7% of the total power plant cost have not made their fair share of progress in reduction in cost of equipment and operating labor, improved load factor and extension of automatic operation.

During the past decade the capacities, pressures, temperatures and efficiencies of individual turbine generators, steam generators and associated auxiliaries have increased considerably, resulting in lower savings of installation and maintenance costs per kw and requiring fewer operators. This progress has been accomplished by fundamental changes in design but aided to a considerable extent by more and better controls, primarily automatic or at least remote manual. By contrast in general, as the larger units required greater quantities of coal, the capacities of the bunkers, belt conveyors, crushers, feeders, etc have merely been correspondingly increased with the usual intermittent, manually supervised operation confined to approximately 40 hours each week.

This paper describes the coal handling facilities being designed for the Milliken Station and incorporating some automatic features that are expected to result in lower installation and operating costs.

Bunker capacity was given careful consideration. With a conventional coal conveying system involving trippers etc, bunkers of two different capacities were considered. The smaller bunker with a width of 55 ft and 22 ft depth had a capacity of 1400 tons equivalent to 28 hours on a maximum burning rate basis. To obtain a bunker capacity of 2000 tons equivalent to 40 hours of maximum burning rate by increasing the height alone (20 ft) would increase the cost by $83,200. If the increased bunker capacity were obtained by adding to both the height (10 ft) and width (19 ft), the cost would increase by $74,100. Thus the incremental cost of the bunker is in the order of $131 per ton of coal stored. These costs include conveyors, bunker steel, building and foundations.

The final plans actually provide for a steel bunker having a capacity of only 700 tons which is sufficient to operate the steam generator for 14 hours at the maximum rating of 1,000,000 lb of steam per hour when the fuel burning rate will be 50 tons per hour. The bunker capacity might have been even smaller without undue jeopardy to continuity of coal supply perhaps in the order of 400 tons or 8 hours at maximum steam generator rating. The actual capacity decided upon was based on building volume resulting from establishing the height by extending the roof above the bunker at the same elevation as the turbine room roof, establishing the length and width by the space required by the pulverizing equipment.

It is our considered judgment that the 700 ton bunker incorporated in the continuous automatic reclaim scheme provides more active storage than the 2000 ton bunker incorporated in a conventional coal handling installation. A 2000 ton bunker is somewhat on the conservative side since our own organization now has 4000 ton bunkers under construction on similar size units for a different client.

All coal delivered to the station is first conveyed to storage. This portion of the facilities is operated manually on an intermittent schedule. The yard storage consists of an inactive volume of some 500,000 tons and an active volume of 5100 tons supported over four reclaim hoppers each incorporating 300-tph remote controlled feeders. Each pair of feeders deliver coal to 300-tph crushers.

The coal leaving each crusher can be discharged to either one of two 300-

(*Continued on page 226*)

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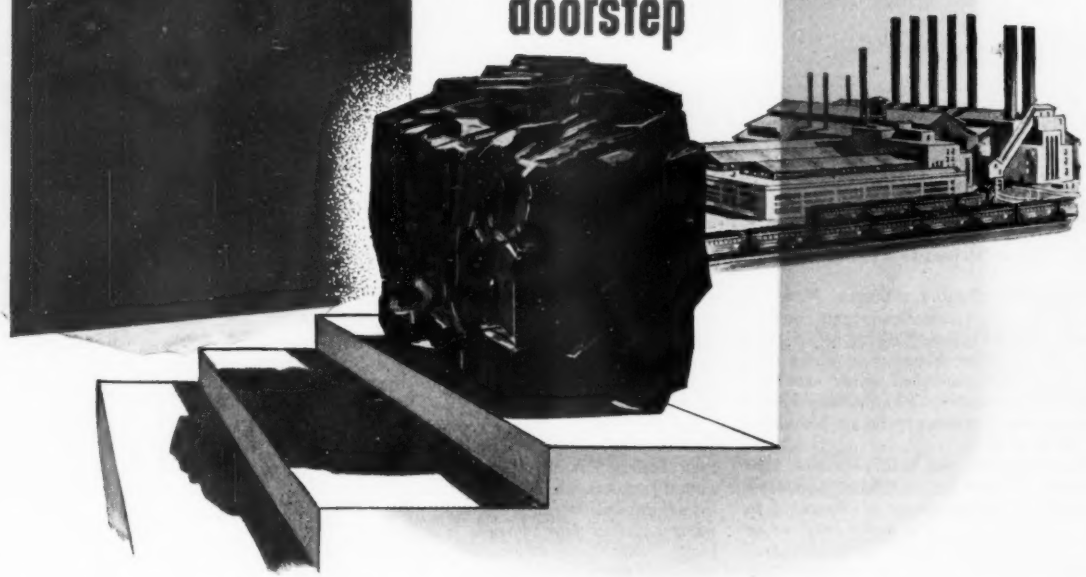
Choose the fuel on Industry's doorstep



Coal is where you find it. Fortunately, however, a large share of the nation's operating Bituminous mines are located in Baltimore & Ohio territory—*economically accessible to America's great industrial plants.* The Bituminous mined here—practically on Industry's doorstep—is of excellent quality and in wide variety; whatever your specific need, there are B&O coals to meet it. Furthermore, the supply is *inexhaustible*—you can count on an *unlimited* reserve of B&O Bituminous, even in emergencies, for centuries to come.

When you consider fuel, consider cost—dependability of service—*accessibility.* You'll choose the Bituminous mined on the B&O. For advice, *ask our man!*

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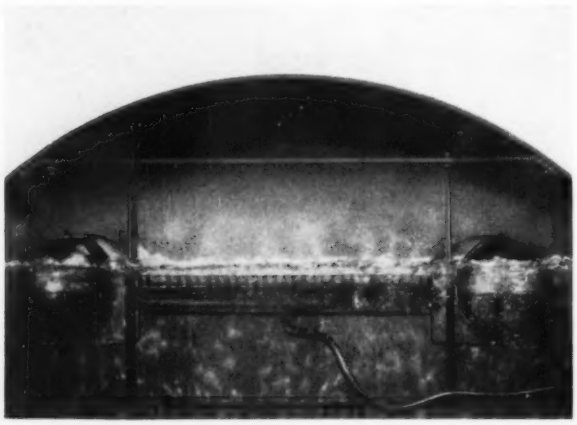


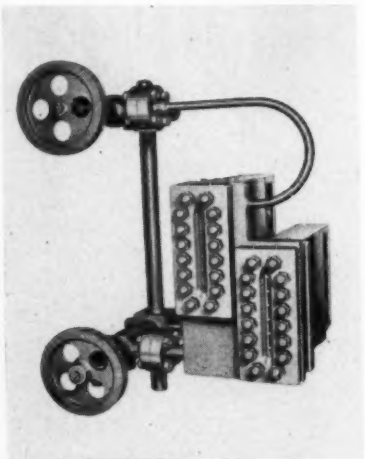
New Skimmer Cleans at Point of Greatest Concentration

1221 • New floating skimmer, *Model A SurfBlow* unit, automatically and continuously skims off boiler water impurities from the critical steam release zone where both dissolved and suspended solids are most heavily concentrated. Manufacturer claims this cuts total necessary boiler blowdown as much as 50%.

Unlike conventional ¾-in. perforated pipe method of collecting continuous blowdown —which of necessity must be located 6 to 10 in. below theoretical water level so as not to blow steam—*SurfBlow* follows fluctuations in water level and therefore can always act at point of maximum concentration. Floats, specially designed for expected operating pressure, are approximately four-fifths submerged so that they will not bob in the turbulent top water in which impurities collect.

Boilers equipped with the new units reportedly come off the line cleaner internally than boilers not so equipped. *SurfBlow* permits substantial reduction in amount of blowdown with resultant savings in treated water and fuel plus increase in steam capacity. Descriptive literature is available upon request to manufacturer.

Boiler Specialties Corp, 608 S Dearborn St, Chicago, Illinois



Boiler Gauge

1224 • New boiler gauges eliminate problem of glass breakage by separating tubes into series of short sections separated by thin mica. Serious strains resulting from increasing boiler pressures and higher steam temperatures are minimized in these short sections and gauge outages caused by glass failure have been cut to a fraction. Gauges are available for operating pressures in excess of 1350 psi. Further information available in Bulletin 1051.

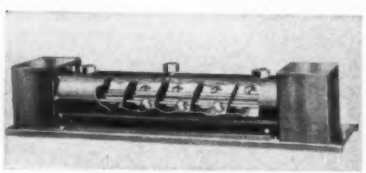
Diamond Power Specialty Corp, Lancaster, Ohio

For more data on these items, use post cards p 167. Identify your request with item number.

Cooling Towers

1234 • New cooling tower design reportedly requires fewer construction parts, permits faster erection and less maintenance. Simplified construction and better use of materials in the *MD-54* are the keys to new design and improved performance features. Basic design allows for largest possible range of size variations. New bracing system provides minimum obstruction to free flow of air, results in better cooling performance. Bracing requires only two specially designed joint connectors in conjunction with three standard braces to build any size or combination of sizes and shapes of tower.

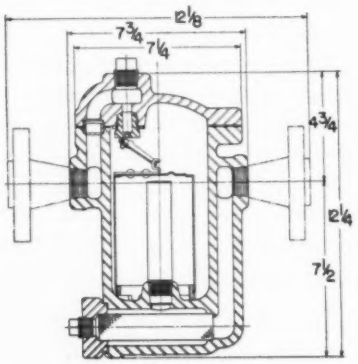
Santa Fe Tank & Tower Co, Los Angeles, California



Water Sterilizer

1212 • Electronic water sterilizer eliminates chlorination, heating and cooling, tank storage. Capable of handling quantities up to 7000 gph, compact sterilizer has no moving parts, weighs only 95 lb and operates on 110-v 60 cycle ac. Unit operates by guiding water through helical baffles into contact with powerful ultra-violet lamps. Further information available from manufacturer.

Aquafine Co, 1005 S Santa Fe Ave, Los Angeles 21, California

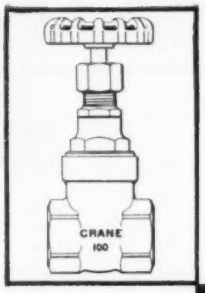


Cast Steel Trap

1215 • New cast steel side-inlet, side-outlet trap with integral strainer contains corrosion-resistant stainless steel mechanism identical in design and construction to mechanism used in traps for 900 F, 950 psig duty. Pressure range is from 0 to 600 psig, maximum capacity, 4400 lb/hr. Connections are ½, ¾ or 1 in., screwed, flanged or socket welded. Additional information available on request to manufacturer.

Armstrong Machine Works, Three Rivers, Michigan

NEW* brass gate valves by CRANE



No. 410,
100-Pound

No. 438,
125-Pound

No. 437,
150-Pound

* NEW SHAPE... NEW STRENGTH

for 3 All-Time CRANE favorites

Here are valves that didn't have to be changed . . . because each has long been the best in its class. But Crane found ways of improvement to give you an even better buy for your brass valve dollars.

For example—here is greater strength, greater rigidity, made possible by the new cylindrical upper body . . . the same basic shape as high-pressure steel valves. Here, too, is an improved stuffing box that screws *into* the bonnet—also better stem support to assure truer alignment and minimize wear on the packing.

And not to be overlooked is their clean, modern appearance—a very desirable advantage for all of your "exposed" installations. Sizes ¼ to 3 in. Ask your Crane Representative all about this improved brass valve line next time he calls.

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new four-page folder with complete facts including sizes, prices and dimensions. Send for yours today. Ask for Brass Valve Folder AD1944.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

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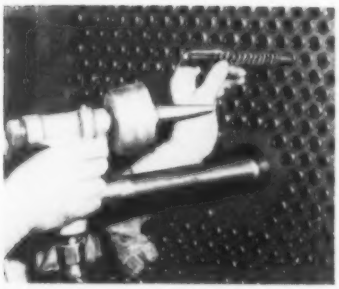
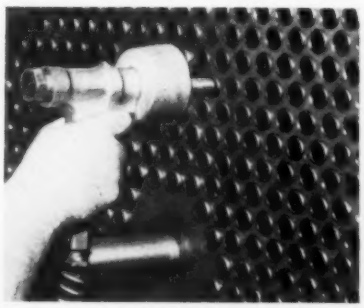
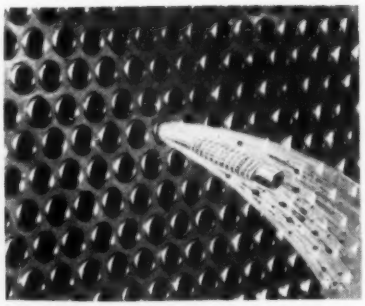
More EQUIPMENT NEWS

Begins on page 158







New Gun Shoots Nylon Brushes Through Condenser Tubes

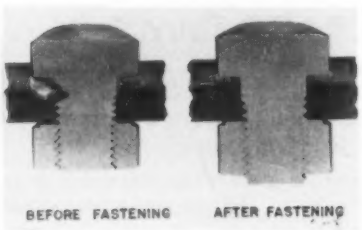
1201 • New condenser tube cleaning apparatus consists of spirally-wound nylon brushes and improved aluminum *Jiffy* gun. Spiral design gives brushes spinning, scouring motion that quickly removes sludge and other soft deposits from small tubes.

Rubber end bumpers or plugs are slightly smaller than brush to permit water to pass and to impart spinning action to close-fitting brush. Manufacturer claims there is no danger of brush sticking in tube or injuring it in any way.

Operator inserts brush in tube and then presses gun nozzle against tube end. This releases water under pressure and permits tight fit between tube and tapered nozzle. Shield behind nozzle diverts any temporary back-flow that may occur before nozzle has made full contact with tube end.

In most condensers, it is unnecessary to open waterbox. Gun can be used and then brushes recovered through handholes at other end of tubes. Further details available in manufacturer's *Jiffy* Gun Bulletin.

Elliott Co, Lagonda Division, Springfield, Ohio



Sealing Device

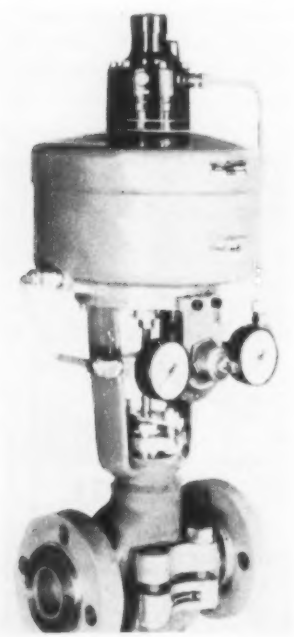
1205 • New sealing device for safe, sure sealing of bolts and studs at either high or low pressure of gas or liquid uses principle of controlled confinement of the sealing gland. *Stat-O-Seal* has one piece construction and is non-directional, cannot be assembled upside-down. Sealing gland fastens mechanically to metal retainer and eliminates failure of bonding agent.

F C Wolfe Co, 3644 Eastham Dr, Culver City, California

Valves

1227 • New series of automatic pressure reducing and regulating valves, *Type BBC*, handle Bunker "C" oil as well as other dirty fluids having a high viscosity. All sizes are of the direct-acting, single-seated, spring-loaded diaphragm type. Units are fully self-contained with simple pressure adjustments. Inner valve and seat are both renewable, both of high grade stainless steel. There are no small ports or passages to foul up even under most adverse conditions, manufacturer claims. Illustrated bulletin No. BBC-1 is available on request.

A W Cash Valve Mfg Corp, Decatur 6, Illinois



Control Valves

1207 • New line of control valves, *LB Series*, introduces entirely new concept of valve topworks. Topwork consists essentially of aluminum cylinder with carefully bored and honed internals, a plastic piston with graphite impregnated "O" ring seal, integral positioning device that permits static or cushion loading pressure to be in either upper or lower cylinder chamber. Coupled with reversible *Conoplug*, it permits any possible combination of forces to cope with unbalanced loads. Operator can position accurately to well over one part in 1000 of instrument output span, manufacturer claims.

New valve series is presently available in sizes up to and including 4 in., and for Series 15, 30 and 60 body ratings. Catalog LB-1, available on request to manufacturer, contains full details on design, materials of construction, application, etc.

Conoflow Corp, 2100 Arch St, Philadelphia 3, Pa.

Surface Tester

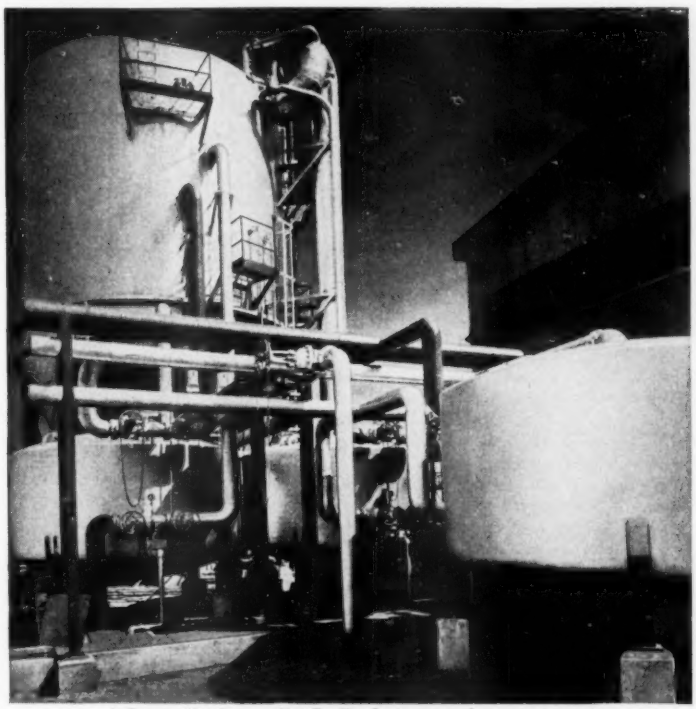
1245 • New tester for controlling slime and other surface fouling features direct visual observation while surface is submerged. This shows true picture of physical condition of surface before disturbing forces of surface tension or air can rearrange or slough away deposit. Further information available from inventor.

L A McKeown, Box 591, Plattsburg, New York

For more data on these items, use post cards p 167. Identify your request with item number.

10 *water-treatment processes* in 1 *system*

- *Softening*
- *Heating*
- *Deaeration*
- *Clarification*
- *Dissolved Solids Reduction*
- *Alkalinity Reduction and low CO_2 in Steam*
- *Silica Reduction*
- *Organic Matter Reduction*
- *Iron and Manganese Removal*
- *Preferential Magnesium Reduction*



A Graver Hot Process-Hot Zeolite System at a large west coast cooperative steam-producing plant.

Easily the most versatile equipment available to the boiler plant engineer today to treat his feedwater is the Graver Hot Process-Hot Zeolite plant. This system can achieve all or any of these results, usually at most economical cost.

Heating and deaeration can be accomplished in the first stage hot process unit with complete deaeration of oxygen to 0.005 ml/liter whenever required.

Clarification of turbid raw water supplies can be obtained in this stage as can alkalinity, dissolved solids and organic matter reduction. Iron and manganese are also removed here.

By adsorption in the first stage with inexpensive magnesium precipitates, silica can be reduced to less than 1 ppm in the treated water.

This plant utilizes resin zeolite which is selective to magnesium, assuring preferential magnesium reduction. This avoids magnesium phosphate boiler sludge —a troublesome product of the older type hot process-hot phosphate system.

A Graver Hot Process-Hot Zeolite plant assures *constant* zero hardness to the boiler *regardless* of the raw water hardness variation, chemical feed adjustment or load fluctuation.

Many Graver installations prove that this versatile system produces an extremely high quality feedwater for higher pressure boilers at economical operating costs.

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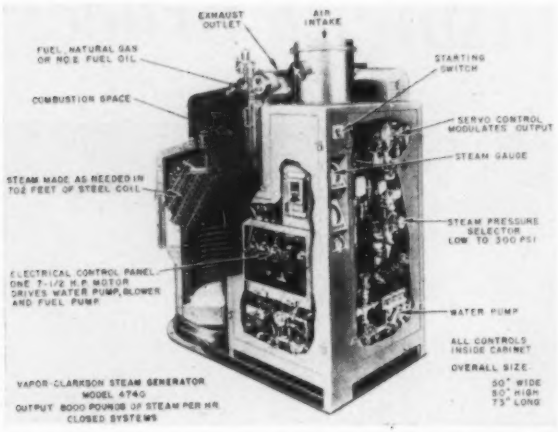
GRAVER EQUIPMENT FOR ALL WATER AND WASTE TREATMENT PROCESSES

Hot Process-Hot Zeolite Softeners

GW478

More EQUIPMENT NEWS

Begins on page 158


EXHAUST OUTLET
AIR INTAKE
FUEL, NATURAL GAS OR NO.2 FUEL OIL
STARTING SWITCH
COMBUSTION SPACE
SERVO CONTROL MODULATES OUTPUT
STEAM GAUGE
STEAM MADE AS NEEDED IN 106 FEET OF STEEL COIL
STEAM PRESSURE SELECTOR LOW TO 300 PSI
ELECTRICAL CONTROL PANEL ONE 7-1/2 H.P. MOTOR DRIVES WATER PUMP, BLOWER AND FUEL PUMP
WATER PUMP
ALL CONTROLS INSIDE CABINET
OVERALL SIZE: 50" WIDE 80" HIGH 73" LONG
VAPOR-CLARKSON STEAM GENERATOR MODEL 474G
OUTPUT 8000 POUNDS OF STEAM PER HR. CLOSED SYSTEMS

Steam Generator Features Non-Interrupting Fuel Switch

1200 • New steam generator, Model OKJ-4740, can change from fuel-oil to natural gas without interrupting steam output. Fuel-oil spray nozzle is incorporated in the metal body of the gas burner.

Flipping selection switch from natural gas to oil closes motorized gas valve and opens fuel-oil solenoid valve, thus releasing oil under pressure to the spray nozzle. Oil, circulating continuously through generator's hydraulic modulating controls, is always ready to be released to combustion chamber. Constant spark and pilot light insure positive lighting.

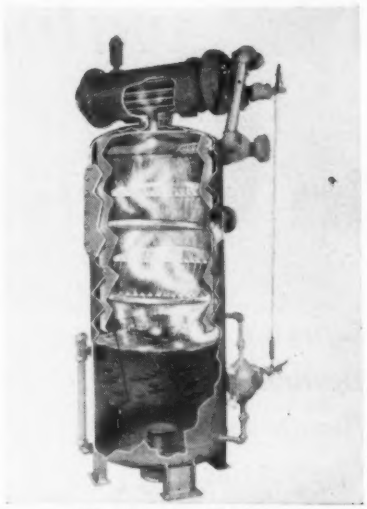
Generator reportedly develops full working pressure up to 300 lb in less than three minutes and makes 1500 to 5000 lb steam per hr. Manufacturer claims it is more than 80% efficient.

Once started, automatic controls cause generator to turn on and off and to modulate output to meet changing demand. Single control can change pressure from 10 to 300 lb. Patented steam separator removes excessive moisture and water treatment particulars so that 99% dry clean steam passes through stop valve into line.

Protective safety controls include: steam temperature limit control, low water shutoff, two safety valves, overload relays, electric eye and others. All controls meet ASME, Hartford and Underwriters specifications.

Unit weighs about 6000 lb, is about ¼ size of conventional prototype. Blower, feedwater pump, 7½-hp motor, steam separator, steel coils and all controls are included in a single package. Generator may be used singly or in banks. Master control automatically turns on units necessary to meet demand at a given time. Additional information available from manufacturer.

Vapor Heating Corp, 80 E Jackson, Chicago 4, Illinois

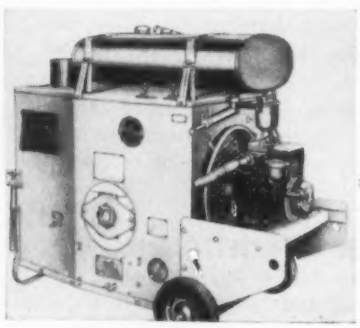


Feedwater Heater

1230 • New spray-type deaerating feedwater heater reportedly operates silently and requires minimum of cleaning and maintenance. Unit has no loose gadgets, baffles or trays. Only part that requires cleaning is spray distributor that is removed easily without breaking any piping connections. Heater operates with a boiler pressure of 75 lb or more, capacities range from 3000 to 300,000-lb preheated feedwater per hr. Further details available from manufacturer.

Stickle Steam Specialties Co, Indianapolis, Indiana

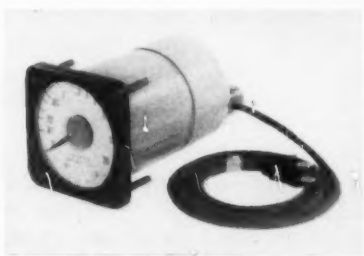
For more data on these items, use post cards p 167. Identify your request with item number.



Portable Air Heater

1240 • Redesigned portable air heater features new streamlined engine that permits modification in mounting and results in simpler, cleaner arrangement of components at air intake end of heater. Fuel metering valve can reduce capacity of unit from maximum 385,000 Btu per hr to 100,000. Gasoline fired, unit is ideally suited to conditions where electricity is scarce.

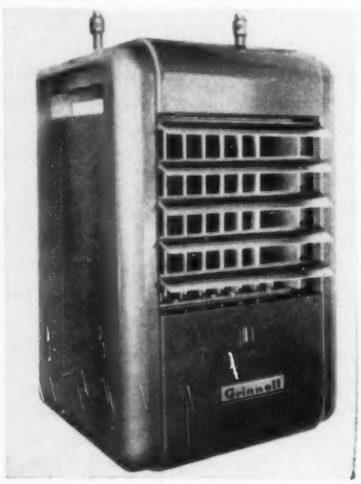
Portable Heater Sales, American Air Filter Co, Inc, Moline, Illinois



Vacuum Gauge

1228 • New molecular vacuum gauge measures pressures without external detectors. Instrument is available in two types, both covering range of 0-20 mm of dry air. Identical except for scale marking, one is calibrated directly for dry air and the other has a linear scale for use where individual calibration for dry air or other gases is preferred. Bulletin GEC-986.

General Electric Co, Schenectady 5, New York



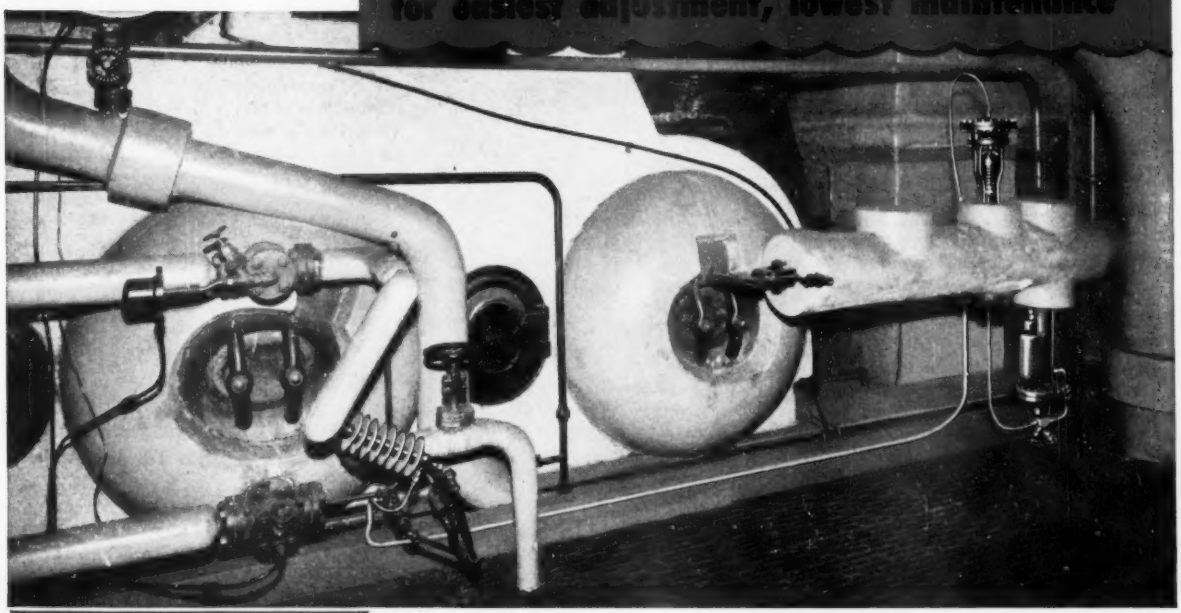
Gas-fired Heaters

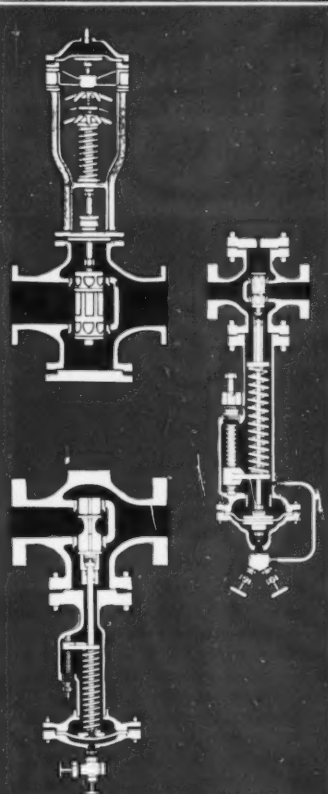
1226 • New line of gas-fired unit heaters for automatic, direct-fired heating of industrial and commercial areas is available in eight models from 20,000 to 160,000-Btu per hr capacities. Heaters can be used with natural, manufactured, mixed or liquefied petroleum gases and are equipped with motor-driven fans ranging from 1/40 to 1/6 hp as well as automatic safety pilots.

Grinnell Co, Inc, 260 W Exchange St, Providence, Rhode Island

Swartwout SC Type FW1 Feed Water Regulators

for easiest adjustment, lowest maintenance





1 **SWARTWOUT SC TYPE FW1** feed water control system consists of thermo-hydraulic generator and regulating valve. Generator piping is a self contained support; no brackets are required. Moving parts are reduced to a minimum. Since there are no floats, levers, turnbuckles or pulleys to line up, regulator valve may be located anywhere. Another plus feature is that speed and degree of generator response can be quickly, easily changed without special tools, cutting or welding.

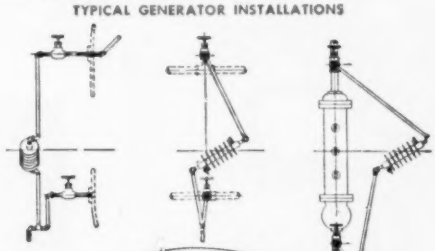
2 **FW1 REGULATING VALVE** is of balanced, tight seating type ruggedly constructed. Long life V-type stem packings. Diaphragm is molded of special rubber with four plys of cord fabric, moves from closed to open position without any stretch imposed on it.

3 **SL DIFFERENTIAL PRESSURE VALVE** can be used with Swartwout FW1 Feed Water Regulators to smooth out erratic feed water pressures. Stainless steel disc, seat, and stem and special formula molded rubber diaphragm.

4 **TYPE A DIFFERENTIAL PUMP GOVERNOR** can be used with FW1 regulating systems to maintain required pump discharge pressure. No stuffing box on moving parts; easy screw type adjustment.

A-8481

TYPICAL GENERATOR INSTALLATIONS



50 YEARS Service to Industry The Swartwout Company 1903 - 1953

Swartwout

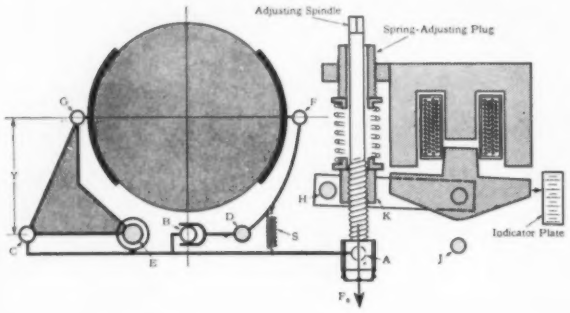
POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION

SEND FOR BULLETIN S-20-E

THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12, OHIO

More EQUIPMENT NEWS

Begins on page 158



New ac Brake Combines Three Adjustments

1202 • Single-adjustment ac brake (Type AK), completely redesigned, combines what were formerly three separate adjustments: (1) spring compression—to control torque (2) magnet travel—to control total shoe clearance from wheel (3) auxiliary screw adjustment—to equalize shoe clearances. Also, a visible indicator tells maintenance crew when and how much to readjust brake for wear.

New brake is applicable to practically all ac motor installations that demand start-stop operation or quick deceleration. Although designed for normal horizontal mounting, it will operate satisfactorily regardless of angle of mounting plane.

Operation is comparatively simple and derives its effectiveness from a unique linkage system. Brake arms pivot on fixed pins *D* and *E*, while lever *ABC* is pivoted to solid arm *GEC* at point *C* and is connected to arm *FDB* at point *B* by a pin riding in a slot. Because of the geometry of the system, force F_s presses the shoes against the wheel with equal pressures.

Any misalignment of the wheel center to right or left of vertical center line of brake causes linkage to pivot about point *A*, but will not change effect of force F_s on the shoes.

With magnet de-energized, adjustment of spindle raises or lowers moving part of magnet. If spindle is turned counter-clockwise until moving part rests on retarding bar *J*, any additional turning raises point *A* and frees shoes from wheel for maintenance.

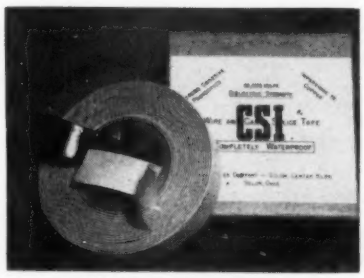
With magnet energized so that trunnion pin *K* is stationary, turning the adjusting spindle increases or decreases amount of shoe clearance. Vibrational turning is prevented by two spring clips.

Maximum impact area results from use of short-stroke clapper-type magnet. Tension spring *S* prevents backlash caused by wear and reversal of thrust in various joints of the linkage. Additional information available from manufacturer.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pennsylvania

CHECK THESE TOO!...

Electric Motors	p 174
Industrial Compressor	p 178
Nozzle Spray Tester	p 182
Plastic Pipe	p 184
Hermetically Sealed Pump	p 190
Gas Leak Detector	p 194
Polyphase ac Motors	p 198
Unit Connector	p 202
Hand Model Lift Truck	p 208
Welding Positioners	p 212



Cable Splice Tape

1216 • Introduced to communications field several years ago, *CSI* cable splice rubber tape is now available to utility, power and industrial fields. New tape is reported completely water proof, resistant to corrosion, impervious to copper. Dielectric strength is 19,000 v. Extreme cohesive properties permit lengthwise application of tape by pinching. Tensile strength is over 19 lb per in. width. Material is supplied foil wrapped in individual packages in standard ¾ and 2 in. 15-ft rolls. Special sizes available to order. Descriptive bulletin and actual samples available from manufacturer.

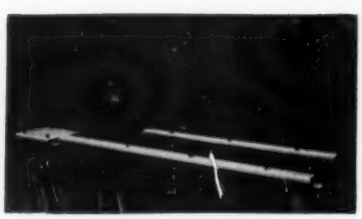
CSI Sales Co, Solon Center Bldg, Solon, Ohio

For more data on these items, use post cards p 167. Identify your request with item number.

Vibration Tester

1225 • New, portable vibration meter, *Type 1-117*, can be used with a hand-held velocity pickup as a probe for tracking down unusual or excessive vibrations. This eliminates the necessity for tearing down entire machine to locate particular source of trouble, manufacturer claims. Unit weighs only 25 lb and can be used wherever standard 115-v, 50/60/400 cycle power is available. Further details available from manufacturer.

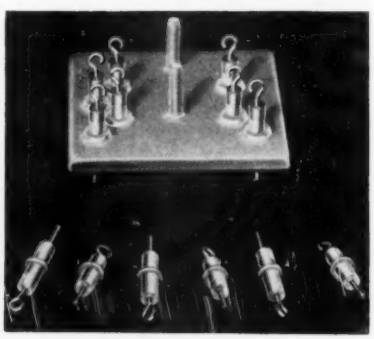
CEC Instruments, Inc, Pasadena 15, California



Isolation Bases

1235 • New mounting bases, designed and built to individual requirements, cut down disturbing and often destructive effects of vibrations transmitted to floors and walls from large fans and compressors. Mounting units, held between steel members running full length of machine, carry weight and match vibration characteristics of installation. Descriptive bulletin covering design and performance details is available on request to manufacturer.

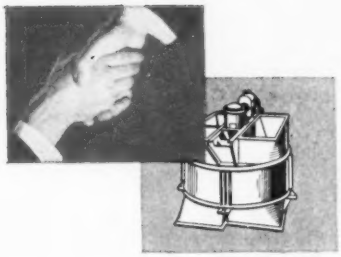
Barry Corp, 85 Pleasant St, Watertown, Massachusetts

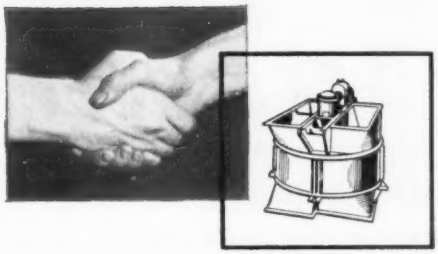


Terminals

1217 • Service at 2000-v RMS without corona—up to 7000-v RMS without flash or tracking—and dimensional stability at temperatures from minus 148 F to plus 300 F are features of new terminals employing insulation injection-molded from "Kel-F" polymer. Chemical inertness, zero water absorption and non-stick properties of the plastic remove any environmental restrictions on use by preventing accumulation of deposits, growth of fungus. Freedom from plasticizers precludes corrosion of conduc-

(*Continued on page* 174)





Why your Ljungstroms are so efficient

—year after year

Air Preheater Corporation Field Engineers aim to visit every Ljungstrom Air Preheater in this country at least once a year. Their main objective is to increase availability and assure you a maximum return on your investment. They are always available for consultation.

This is just another reason why the Ljungstrom Air Preheater is *the most economical heating surface on the modern boiler.*

THE AIR PREHEATER CORPORATION

60 East 42nd Street
New York 17, N. Y.

Low Cost *Installation*

FACTORY PACKAGED RECTIFIER UNITS CUT INSTALLATION TIME AND COSTS

The factory packaged design of Allis-Chalmers sealed tube mercury arc rectifiers cuts labor time and costs. All component parts are metal-enclosed and integrally connected into one complete unit. This unit can be located convenient to your dc load center to cut dc feeder cost and reduce dc distribution loss . . . requires no special concrete foundation. And because of its light weight, it can be installed on a balcony or elsewhere to conserve valuable floor space. Only connection to power and control leads and to cooling water supply is necessary to make unit ready for service.

Allis-Chalmers sealed tube rectifiers are offered in ratings from 200 kw at 250 volts to 1000 kw at 600 volts.

When you are planning a new dc power installation of *any* size, it will pay you to investigate the many cost cutting features of the Allis-Chalmers rectifiers. For complete details, call your nearest A-C sales office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4144

MERCURY ARC RECTIFIERS

This 500 kw Allis-Chalmers factory packaged mercury arc rectifier unit is installed at a large Wisconsin plumbing fixture manufacturer. From left to right, the unit consists of dc feeder and cathode breaker compartments, rectifier tube compartment, rectifier transformer, and 12.5 kv ac switchgear compartments. Since its installation, this unit has greatly reduced costs of dc electric service to cranes, material handling equipment and machine tools.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your requests to the various companies, they'll send the info

Want quick direct-from-manufacturer service?

USE THESE CARDS

- First check what you need: more information on a new product or an ad, copies of free catalogs, bulletins
- Then describe the product, or literature desired. Give model numbers, bulletin numbers wherever you can
- Be sure to write in number of page on which item appeared, and issue of POWER in which you spotted it
- Finally, address reverse side of card to the manufacturer concerned

If you like this quick, direct-to-manufacturer service, we'll gladly send you a supply of cards

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I want details on these New Products... 12/53

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Send me these FREE Catalogs and Bulletins...

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My Name.....
Please print
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Please use before April 1, 1954. Void after this date.

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New York 36, N. Y.

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Describe item here

_____

It appeared on page_____of the_____issue of POWER.

My Name .....
Please print

Title .....

Company .....

Street Address .....

City, State .....

This month's FREE Literature

AIR CONDITIONING

1 **Direct drive blowers** with or without speed control for heating, cooling and ventilating equipment. Two-color, 4-page brochure. Photos, dimensional drawings, performance curves, engrg data. Morrison Products, Inc, 16816 Waterloo Rd, Cleveland 10, Ohio.

2 **Liquid seals** for keeping high-pressure refrigerant gas out of evaporator when liquid level in receiver drops below outlet pipe. Selection, installation, operation data. Four-page, illustrated folder. Bulletin 241, Armstrong Machine Works, Three Rivers, Mich.

3 **Dry-type panel** filters for removal of airborne impurities in ventilation and air-conditioning systems. Two-color, 8-page booklet. Photos, dimensional drawings, full specs, engrg and performance data. Bulletin 600, Dollinger Corp, 11 Centre Park, Rochester 3, N. Y.

BOILERS & AUXILIARIES

4 **Steam generators** and allied equipment to meet wide range of loads, pressures and temperatures for power, process and space heating. Two-color, 20-page booklet. Design drawings, photos, brief summaries of salient features. Bulletin G. B.-153, Union Iron Works, Erie, Pa.

5 **Shop-assembled** Type H water-tube boilers in ten standard sizes ranging from 8000 to 30,000 lb steam per hour. Two-color, 4-page folder. Photos, dimensional drawings, full specs. Bigelow Co, New Haven 3, Conn.

6 **Orifice meter** with 17 calibrated orifices for accurate selection of correct rate of flow for any type or size of boiler and any water condition. Two-color, 4-page illus folder. Madden Corp, 1543 Morse Ave, Chicago 26, Ill.

7 **Refractory products** for critical areas in heat and power boilers. Two-color, 32-page booklet. Photos, dimensional and sectional drawings, detailed specs, engrg data. Norton Co, Refractories Div, New Bond St, Worcester 6, Mass.

CONTROLS, ELECTRICAL & MECHANICAL

8 **Key switches,** impulsing devices, switchboard lamps, jacks and caps and other control devices. Two-color, 28-page catalog. Photos, diagrams, specs, general data. Catalog 4018-D, Automatic Electric Co, 1033 W Van Buren St, Chicago 7, Ill.

9 **Packaged metered control** unit and other automatic combustion controls for oil, gas or coal-fired boilers. Four-page, 2-color folder. Photos and installation diagrams. Bulletin C-101, Reliance Instrument Mfg Corp, Glen Cove, L. I., N. Y.

10 **Electronic controls** for heating, ventilating, air conditioning. Two-color, 8-page booklet. Photos, diagrams, application and installation data. Barber-Colman Co, Rockford, Ill.

11 **Combustion controls** for coal, oil and gas systems—master regulators, draft regulators, fuel-air ratio controllers, smoke alarms, power units and robot-eye photoelectric fuel-air ratio controllers. Two-color, 4-page folder. Photos and installation sketches. Standard Instrument Corp, 350 Fifth Ave, New York 1, N. Y.

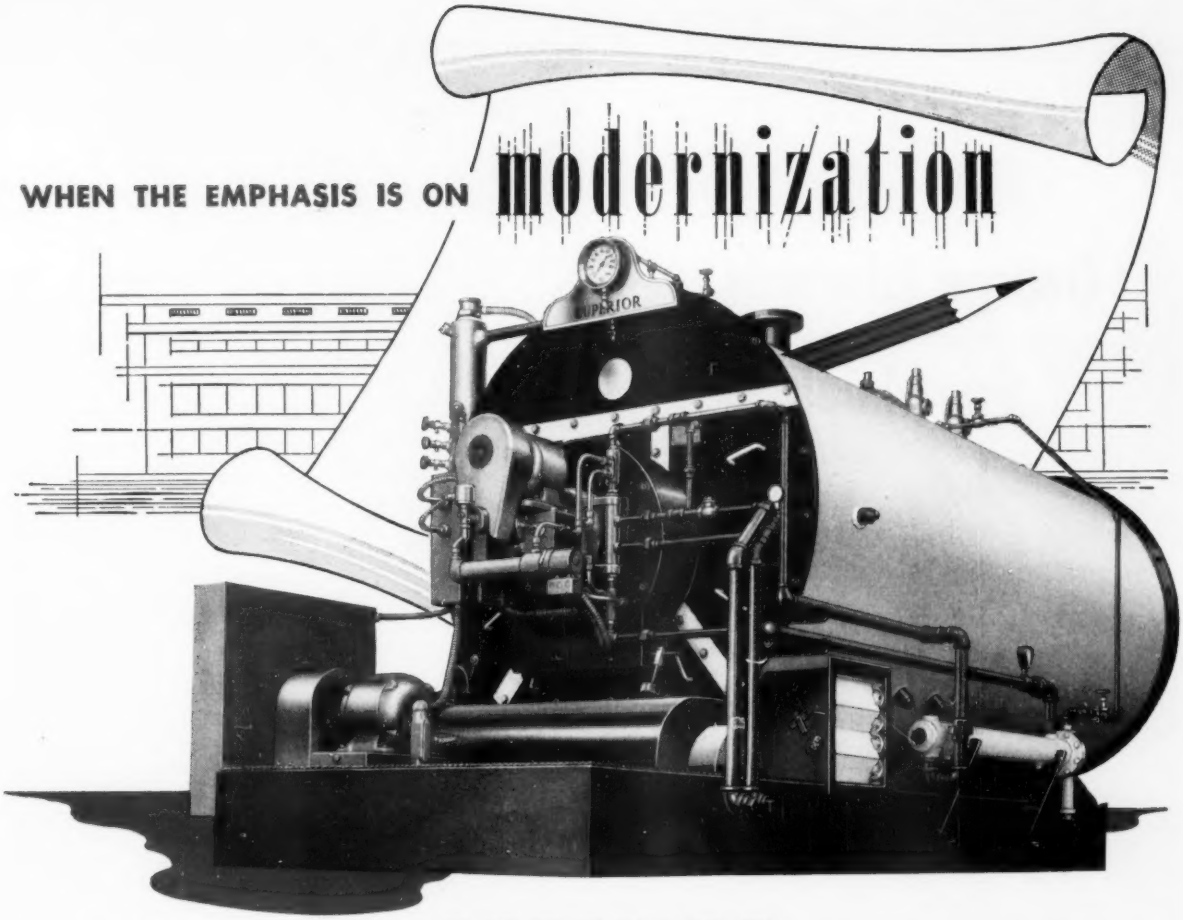
ELECTRICAL EQUIPMENT

12 **Technical data book** on rubber-insulated power cables for use up to 35,000 v. 128-page book. Complete technical information, 29 pages of detail drawings for splicing and terminating high-voltage, rubber-insulated cables. OK-1075, Okonite Co, Passaic, N. J.

13 **Hydraulic-magnetic** overload relays for protecting electrical equipment. Two-

(Continued on page 248)

WHEN THE EMPHASIS IS ON **modernization**



CUT STEAM COSTS WITH SUPERIOR STEAM GENERATORS

LET'S FACE IT!

Fuel, labor and maintenance are the big elements of steam cost. They completely overshadow original cost of equipment. Fuel costs are higher, wages are climbing . . . and surveys show that 2 out of 3 boilers are obsolete . . . while competition in almost every field is keener. If you are looking for opportunities to cut operating costs, talk with a Superior engineer. Write for Catalog 500.

Complete, compact, and efficient, SUPERIOR Steam Generators are the easiest and quickest means to boiler room modernization. Shipped complete after factory tests which guarantee more than 80% thermal efficiency, SUPERIOR Steam Generators are designed for long-run economy, and backed by undivided responsibility.

Installation is simplified for speed and economy . . . requiring no special foundation, no expensive chimney other than a vent for exhaust gases . . . puts steam where used, eliminating long steam lines. Compact design saves space and construction costs.

Fully automatic operation with any grade of oil or gas assures maximum fuel economy with minimum supervision. Ample heating surface (min. 5 sq. ft. per b.h.p.) assures operation at capacity without overfiring. Built-in induced draft makes boiler rooms cleaner, quieter, and safer.

Modernize with a modern SUPERIOR Steam Generator.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

George Edwards' Scrapbook

This guy's portrait reminds me of an old timer in my first power plant. Being a youngster and inexperienced, I naturally pulled boners. Or I was a little awkward in handling some job.

Instead of old Charlie showing me the RIGHT *way, he'd open his big mouth and cuss a blue streak.*

I've found it good practice to give every youngster a fair chance. Grownups should be mature enough to look the other way (now and then) when youth pulls a boner—especially when no damage is done.

Too often the least promising looking lad turns out to be the best man when handled right. If he doesn't fit in somewhere along the line, he'll eventually hang himself anyway.

Visited an enthusiastic group of engineers recently in a fast growing firm.

"How come you boys are all wrapped up in your work and have all that ginger?" I asked.

"Simple," said the department head. "Whenever a new job opens up, we post it on the bulletin board in one of our dozen plants. Everyone interested can apply. Each applicant is screened carefully. If possible, we always select someone from our firm, instead of going outside. Recently a young engineer jumped an older man who had 12 years' seniority. This plan allows men to select the job they are most interested in. Reward ability and try to put each square peg in a square hole and you can't help but have enthusiastic employees."

* * *

Out of the night that covers me,
Black as the pit from pole to pole,
I thank whatever gods may be
For my unconquerable soul.

In the fell clutch of circumstance
I have not winced nor cried aloud.
Under the bludgeonings of chance
My head is bloody, but unbowed.

Beyond this place of wrath and tears
Looms but the Horror of the shade,
And yet the menace of the years
Finds and shall find me unafraid.

It matters not how strait the gate,
How charged with punishments the scroll,
I am the master of my fate:
I am the captain of my soul.

from "INVICTUS"—WM ERNEST HENLEY

* * *

Here's a good definition for preventive maintenance:

Doing a thing today when it does not have to be done, instead of doing it tomorrow when it must be done.

"Knowledge is **power.**" —FRANCIS BACON

But it can't make you happy unless you have the common sense to go with it.

* * * *

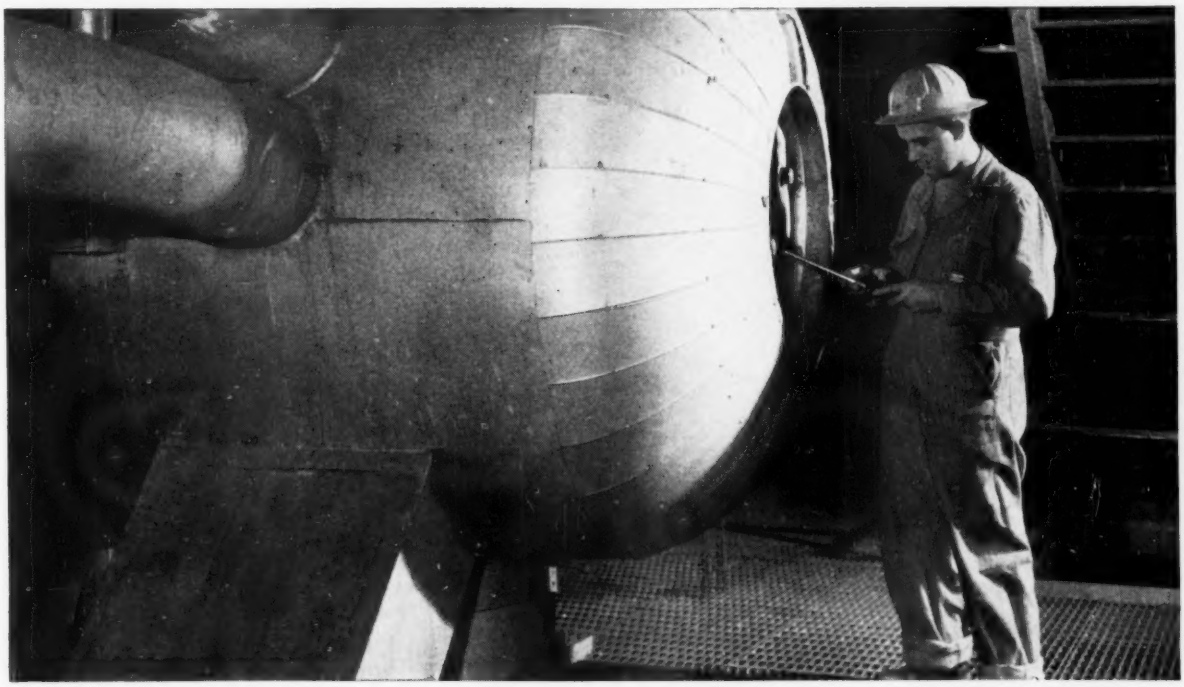
Seems like only yesterday that the gas turbine was a laboratory experiment. Not only are units made on assembly lines for stationary use now, but also I read that the gas-turbine Shell tanker *Auris* has already steamed 5100 hours at full load. Besides, a French test automobile with a 100-hp gas-turbine engine is on the road in France.

These items struck my funny bone because just the other day, old Jim Harris from our local brewery dropped in with an improvement on their Corliss engine dashpot. He wanted my advice before applying for a patent.

George Edwards
Engineer

CHEMICAL CLEANING PROVED MORE EFFECTIVE IN BOILER TEST

DOWELL method showed greater efficiency by 4.5% in utility company comparison



Perhaps the most convincing way of demonstrating the advantages of one method of cleaning over another is to conduct a comparative test.

That's exactly what one of the larger utility companies did to compare chemical cleaning with mechanical cleaning. The 23-day test was conducted with companion boilers, rated at 200,000 lb. per hour operating at 500 p.s.i. One boiler was chemically cleaned by Dowell in 12 hours, the other was turbined in one week.

At the conclusion of the test, the boiler which was chemically cleaned by Dowell had a 4.5% greater efficiency factor. It also used 10% less coal per KWH gross produced than the other boiler. With results like this to cite, it's no wonder leading plants in all parts of the country rely on Dowell service for their maintenance cleaning.

Dowell engineers do the job for you, using liquid solvents which are brought to your plant in truck-mounted tanks along with all necessary pumps and control equipment. No special scaffolding is required. Dismantling and down-time are kept to a minimum; equipment can often be cleaned while in operation.

For complete information and estimates on cleaning your equipment, call the nearest Dowell office, or write directly to Tulsa, Dept. L23.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

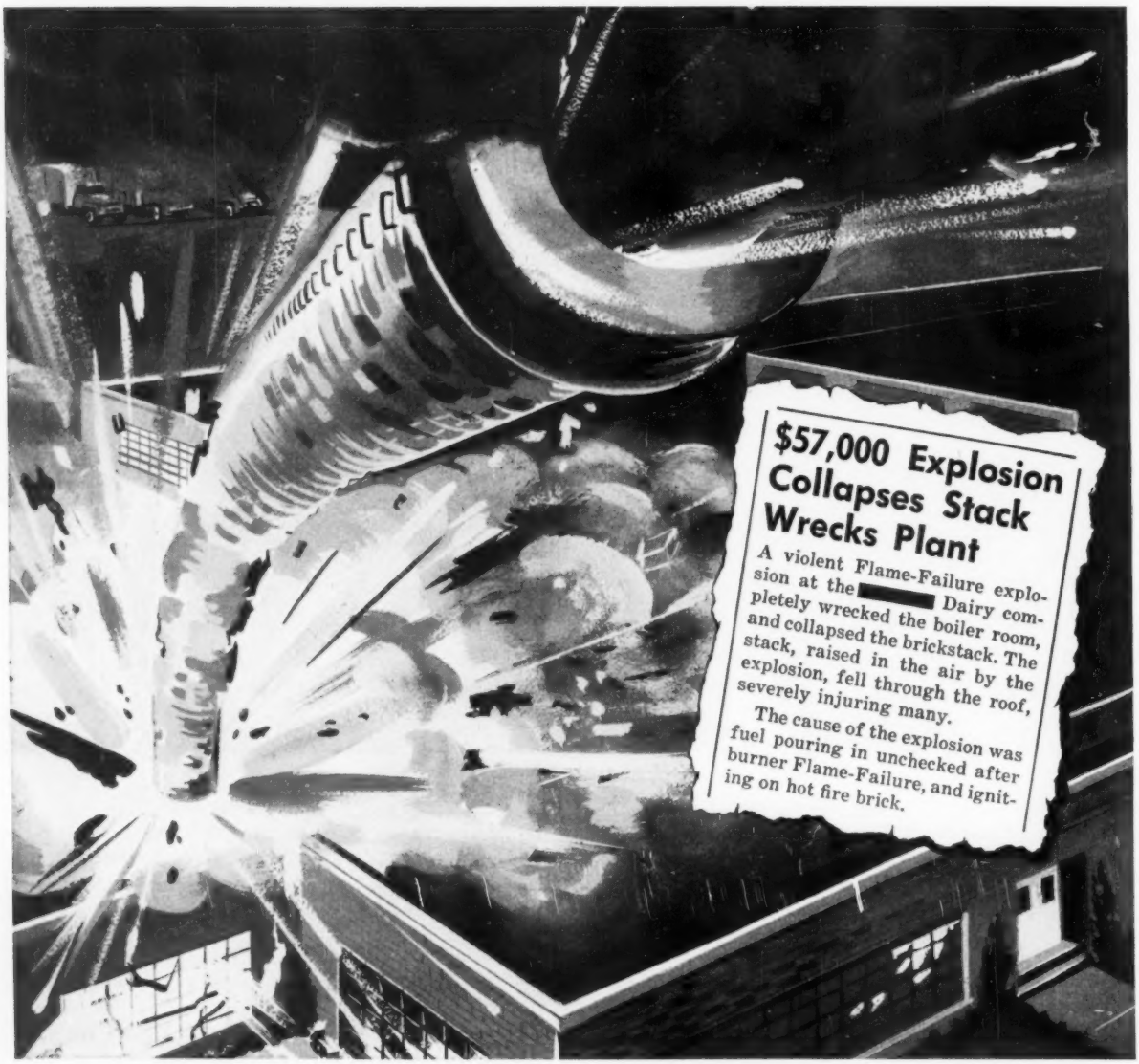
Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED · TULSA 1, OKLAHOMA

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

This explosion wrecked


$57,000 Explosion Collapses Stack Wrecks Plant
A violent Flame-Failure explosion at the [redacted] Dairy completely wrecked the boiler room, and collapsed the brickstack. The stack, raised in the air by the explosion, fell through the roof, severely injuring many.
The cause of the explosion was fuel pouring in unchecked after burner Flame-Failure, and igniting on hot fire brick.

COVERING THE U. S. A. and Canada, factory-trained field engineers provide "know-how" of Flame-Failure safeguarding with FIREYE.

a power plant . . .

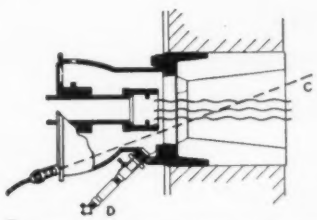
IF YOUR PLANT is like 4 out of 5 today, it is unsafe.

For 4 out of 5 plants burning oil, gas or coal simply do not have Flame-Failure protection that meets insurance company standards . . . *automatic safeguards for commercial and industrial burners should shut off fuel in 2 to 4 seconds after a burner Flame-Failure!* Explosive gases collect fast. Faster, actually, than most mechanical "safeguards" can act.

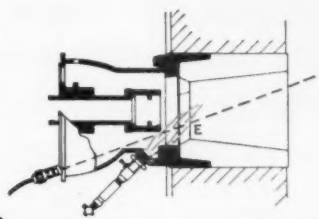
So don't depend on slow, half-safe controls that may be no protection at all. Act before it is too late in replacing them with a modern, fully approved FIREYE System . . . the only complete and instantaneous safeguard for all types of fuels. With FIREYE, an electronic eye "sees" the burner flame . . . works with the speed of light when it goes out, to cut off fuel and signal operating personnel.

Thousands of installations the country over, prove FIREYE has no equal for reliability. It can be applied to oil, gas, coal burners "overnight" — for a negligible investment.

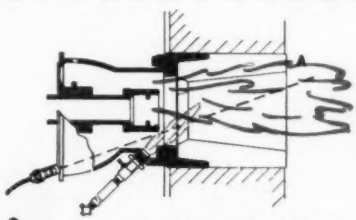
How fireye works to give you complete Flame-Failure protection



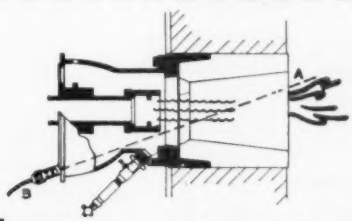
1. FIREYE purges combustion chamber (C) before igniting pilot (D). This eliminates dangerous gases which may have accumulated from leaking valve during down time.



2. FIREYE proves pilot flame (E) before turning on main fuel. Pilot may fail to light because of fouled electric ignitors, no fuel, or poor fuel-air mix.



3. FIREYE shuts down burner if main flame (A) is not ignited at end of safe-trial period (due to no fuel, poor fuel-air ratio or incorrect draft).



4. FIREYE shuts down burner in 2 to 4 seconds if main flame fails due to poor fuel-air ratio or draft, or fuel interruption. POSITIVELY PREVENTS EXPLOSION!

fireye®

PLAY SAFE! SEND NOW!

Why take chances?

Even with modern equipment, the chances are 4-to-1 you do not have complete Flame Failure protection. Send for this new "primer" on explosion hazards that tells how you can make simple checks on the equipment you now have.

COMBUSTION CONTROL CORPORATION
Dept. PB-12, 718 Beacon St., Boston, Mass.

Send booklet "Guarding Your Properties Against Flame-Failure Explosions".

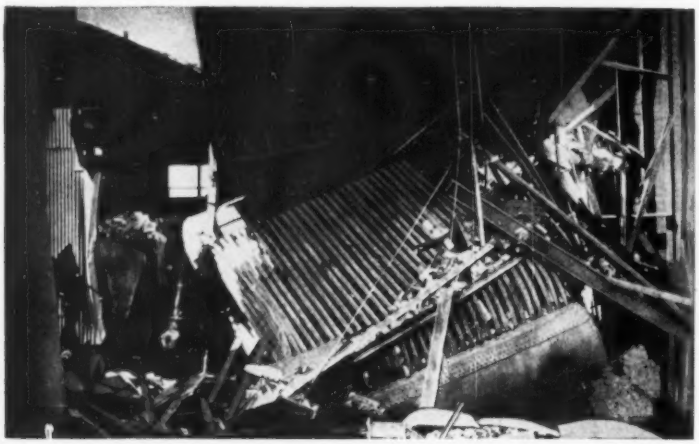
Name ..... Title .....

Firm .....

Address .....

City ..... State .....

DON'T TAKE CHANCES ON FLAME FAILURE EXPLOSIONS



CALL ON YOUR NEAREST FACTORY-TRAINED ENGINEER TO EXPLAIN ABSOLUTE SAFEGUARDING WITH

Learn about Fireye from our advertisement in this issue

fireye

Area Offices of Combustion Control Corp.

ATLANTA, GA. Evergreen 9588
BOSTON, MASS. Commonwealth 6-7585
CHICAGO, ILL. Reliance 5-6030
CLEVELAND, O. Cherry 1-5725
DALLAS, TEX. Dixon 3072
NEW YORK, N. Y. Hanover 2-4737
PHILADELPHIA, PA. Locust 7-5922
SAN FRANCISCO, CAL. Exbrook 2-8700
WASHINGTON, D. C. Columbia 3322

District Offices

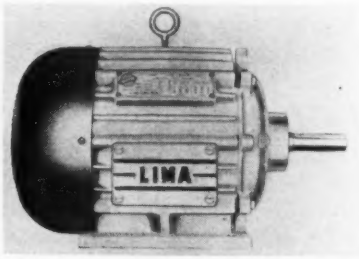
AKRON, O. Slawson Equipment Co. Franklin 9833
ALBANY, N. Y. G. W. Heacock Co., Inc. Albany 4-5360
ALBUQUERQUE, N. M. Automatic Equipment Co. Albuquerque 6-0753
ATLANTA, GA. Spotswood Parker Co. Walnut 3658
BUFFALO, N. Y. Niagara Electric Sales Co. Summer 4000
CHARLESTON, W. VA. G. H. Zimmerman Co. Charleston 22-212
CHARLOTTE, N. C. James L. Highsmith & Co. Charlotte 5-6436
CINCINNATI, O. Richard Equipment Co. Cherry 3240
CLEVELAND, O. Slawson Equipment Co. Express 1-7263
DAYTON, O. Richard Equipment Co. Michigan 6461
DENVER, COLO. Automatic Control & Equipment Co. Keystone 2055
DES MOINES, IA. Delavan Engineering Co. Des Moines 8-5721
DETROIT, MICH. D. T. Randall & Co. Woodward 2-4267
HOUSTON, TEX. Industrial Equipment Co. Yukon 5431
INDIANAPOLIS, IND. I. W. Cotton Co., Inc. Lincoln 4433
KANSAS CITY, MO. Hinds & Associates, Inc. Harrison 4145
LOUISVILLE, KY. Richard Equipment Co. Wabash 3235
MEMPHIS, TENN. Industrial Boiler & Equipment Co., Inc. Tel. 37-7760
MILWAUKEE, WIS. V. P. Hansen Co. Daily 8-2338
MINNEAPOLIS, MINN. Engineered Sales Co. Locust 0696
MONTREAL, QUE. Martin Engineering, Inc. Wilbank 4185
NEW ORLEANS, LA. David A. Warriner Co. Walnut 0735
ODESSA, TEX. Snyder Co., Inc. Tel. 6-4802
PITTSBURGH, PA. Russell F. Clark Co. Atlantic 1-8089
PORTLAND, ORE. W. R. Norte Co. Tuxedo 3459
RICHMOND, VA. Carroll G. Traylor Co. Richmond 6-2337
ROANOKE, VA. Carroll G. Traylor Co. Roanoke 2-6548
ROCHESTER, N. Y. Niagara Electric Sales Co. Hamilton 5166
ST. LOUIS, MO. Hester-Bradley Co. Franklin 3406
SALT LAKE CITY, UTAH Leonard M. Slusser Salt Lake City 5-2322
SAN FRANCISCO, CAL. Continental Control Co. Sutter 1-4464
SEATTLE, WASH. R. H. Liniger Co. Adler 2305
SOUTH BEND, IND. Havel Brothers South Bend 3-2193
SPOKANE, WASH. East Point Sales Co. Madison 0183
TAMPA, FLA. Industrial Specialties Sales Tampa 8-1237
TORONTO, ONT. Martin Engineering, Inc. Waverly 7533
TULSA, OKLA. Snyder Co., Inc. Tulsa 4-0126
VANCOUVER, B. C. Pacific Controls Co. Tatlow 1228
WASHINGTON, D. C. Gibson Engineering Oliver 2-7400

COMBUSTION CONTROL CORP., Dept. PB-12A, 718 Beacon St. Boston, Mass.

More EQUIPMENT NEWS

Begins on page 158

tor or adjacent metal components. Further details available from manufacturer.
M W Kellogg Co, Chem Mfg Division, Jersey City 3, N. J.



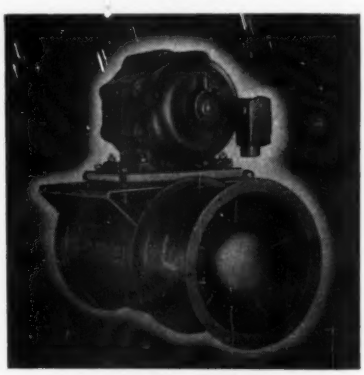
Electric Motors

1210 • Redesigned line of totally-enclosed fan-cooled motors is available in ratings from ¾ hp at 900 rpm to 20 hp at 3600 rpm in NEMA frame sizes 224 to 326 inclusive. Motors are available for vertical, wall or ceiling mounting and standard horizontal mounting. Descriptive brochure available on request.
Lima Electric Motor Co, Dept 164, Lima, Ohio

For more data on these items, use post cards p 167. Identify your request with item number.

Reclosing Relay

1236 • Automatic reclosing relay controls reclosing operation of circuit breaker, prevents repetitive tripping of protective relay. This feature is desirable where feeders are sectionalized by fuse operation since closed circuit breaker will then allow fuse to clear faulted feeder. Relay is available with adjustable integrating lock-out device that limits successive circuit breaker reclosures to a safe value. Further details from manufacturer.
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

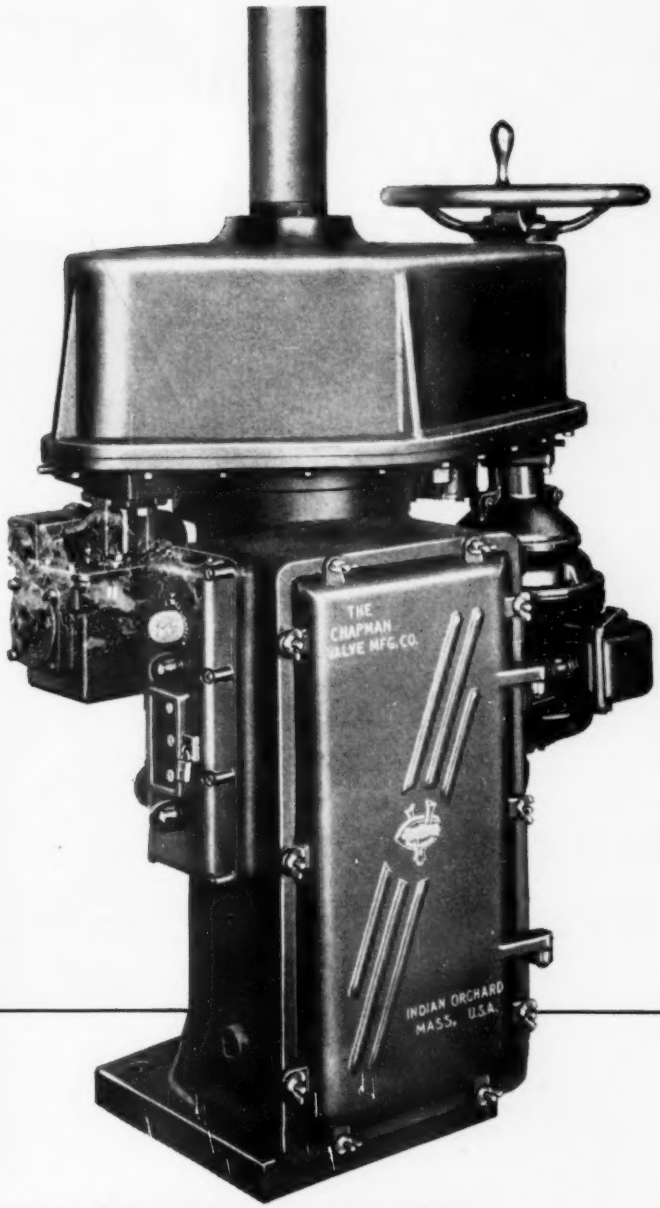


Vaneaxial Blower

1241 • High-temperature vaneaxial blower moves air at temperatures up to 350 F, and air containing acids, alkalies or fine abrasive dust without premature failure of belts and bearings. Addition of special dummy section containing guide vanes makes possible location of drive on negative pressure

(*Continued on page 178*)

SMART OPERATOR for Valves, Gates and Floorstands



CHAPMAN'S MOTOR UNIT

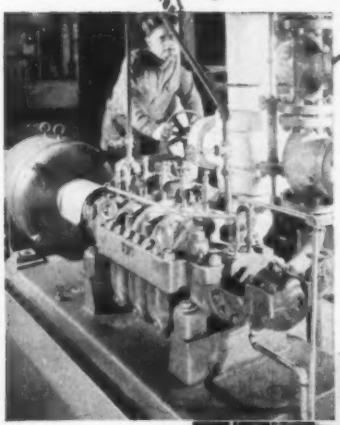
Instant control of valves and large sluice gates at the touch of a button . . . that's what you get with Chapman Motor Units on the job. Completely housed and thoroughly dust and weather proof, these units are built "to take it" for years, on the roughest service. They're designed for simplicity and extreme ruggedness, as shown by internal view above.

Chapman Motor Operated Floorstands are delivered to the job with all internal wiring complete, so all the wiring to be done is to bring the power leads into the connection box... saving time and money in installation and assuring proper operation. Write for Catalog No. 50.

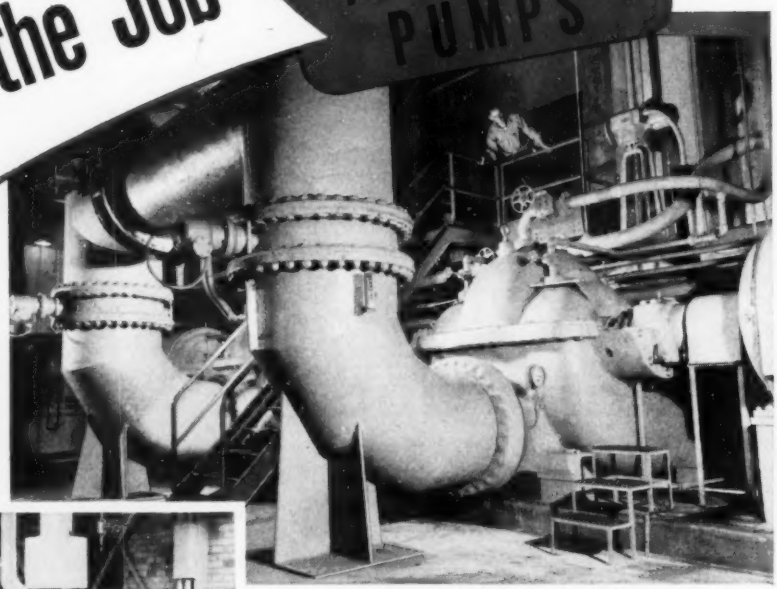
The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

Engineered to Fit the Job

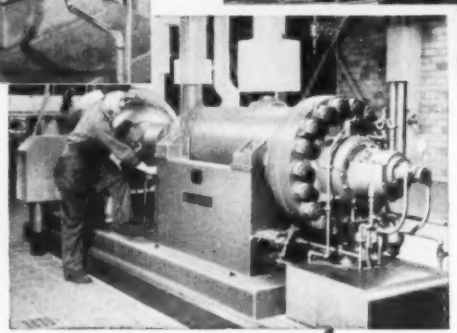
ALLIS-CHALMERS Power-Plant PUMPS

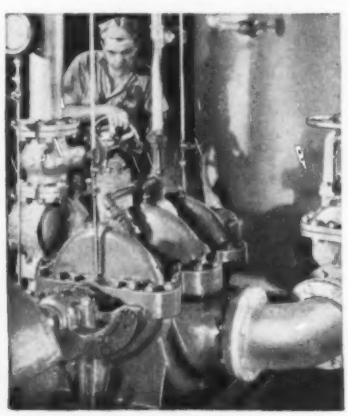


For boiler-feed service, Type M pumps provide heads up to 1200 psig. Barrel-type pumps offer high efficiencies in the pressure range of 1200 to 3000 psig, in ratings from 300 to 2500 gpm. Units shown are (above) 175 gpm, 1325-ft head and (right) 480 gpm, 4271-ft head.



These double-suction centrifugal circulating water pumps are rated 35,000 gpm, 20-ft head. A-C also builds vertical axial and mixed flow types — providing a broad line that covers all installation requirements.





Condensate pumps are designed and built for operating under vacuum and handling liquid at or near its boiling point. They are available in single and multi-stage types for vertical and horizontal mounting.

WHEN YOU TURN to Allis-Chalmers, you get triple insurance that each pump will fit your requirements:

(1) You gain application engineering based on more than 60 years of centrifugal pump experience and research . . . (2) You select from a wide, diversified line, with each pump custom-engineered for its specific job . . . (3) You get pumps that are individually tested, on the most modern test floor in the industry, to assure complete compliance with the specifications.

This triple insurance can cover all of your major pump requirements . . . from high-pressure boiler-feed units to solids-handling ash sluice pumps . . . horizontal or vertical . . . centrifugal, mixed or axial-flow types. You gain by calling in your A-C representative for help.

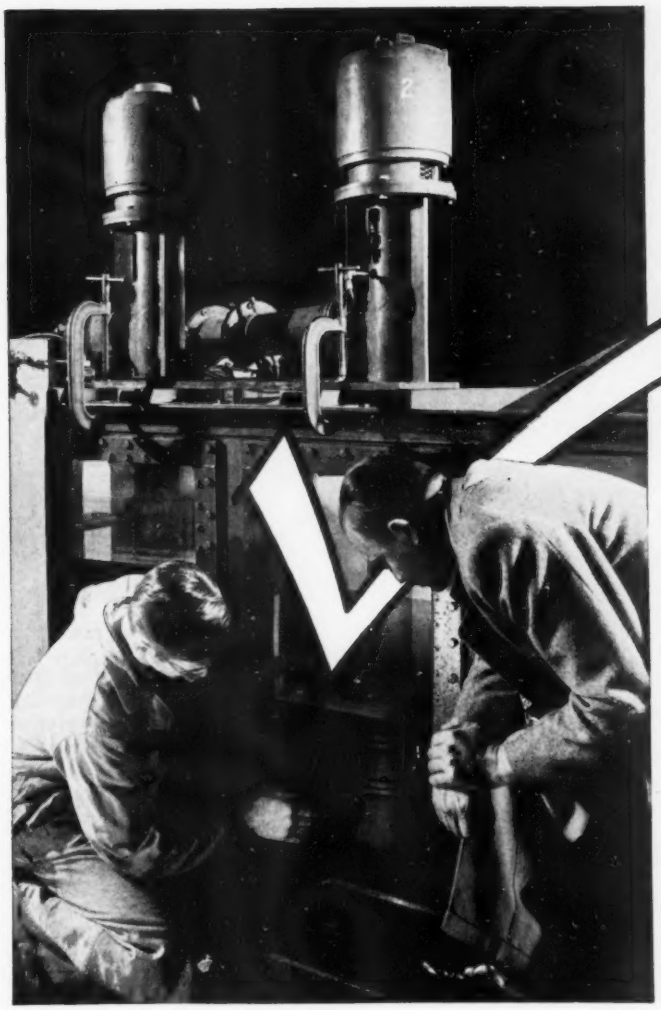
WRITE FOR *Bulletin 52B6059, listing Allis-Chalmers pump types and ratings.*

A-4141B

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Milwaukee 1, Wisconsin



ALLIS-CHALMERS

PUMP Laboratory

Check

Suction Bay and Pump Performance in Advance

Use this Allis-Chalmers pump laboratory to duplicate your suction bay design and operating conditions.

WHY CHANCE EXPENSIVE BUILDING ALTERATIONS when you can be sure of suction bay and circulating pump performance in advance. In the Allis-Chalmers pump laboratory, an exact scale model of your suction bay can be built. Then you observe the effects of different foundation arrangements . . . can check efficiencies under partial load . . . test the ultimate capacity of your design in case of expansion . . . see what happens under different water conditions. This way you can be sure that you have the right design, down to the last detail.

Available to Power Plant Operators and Consulting Engineers

The Allis-Chalmers pump laboratory is located at the West Allis, Wisconsin, Works and is available for use for all power plant operators and consulting engineers with large pump and water supply problems. For details of the services available, call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3973

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Every
RIDGID
Is Work-Tested...
Before It Leaves the Factory

...to make sure
it gives you the
Best and the Most
wrench service for your money

The reason RIDGID Heavy-Duty Pipe Wrenches are known for the brutal punishment they can take is because of the toughness built into them, checked part by part and then hard work-tested when assembled . . . not just one wrench in 100 or 1000 but *every last one!* . . . Add the guaranteed repair-free housing, no-slip no-lock jaws, handy pipe scale, easy spinning adjustment nut and comfort-grip I-beam handle and you see why genuine RIDGID gives you the big value for your money. Buy them at your Supply House.

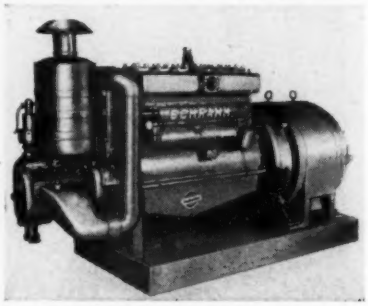
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID
Work-Saver Pipe Tools

More EQUIPMENT NEWS

Begins on page 158

side of blower. With this arrangement, clean air from outside the duct enters through belt tube and over bearings. Complete removal of vulnerable parts from contact with destructive elements in air-stream insures long life and trouble-free operation, according to manufacturer. Units are available in sizes from 12 to 54 in.
Hartzell Propeller Fan Co, Piqua, Ohio



Industrial Compressor

1204 • Model 600 *Super Unistage* industrial air compressor provides 600 cfm at 100 psi. Unit is recommended for either unit system installation or as a central supply if 600 cfm is sufficient to meet entire air needs. Powered by a 150-hp induction motor, *Super Unistage* reportedly has 43% greater capacity than largest of earlier models, yet requires little more actual floor space for installation. Unit is vibrationless, can be installed without expensive foundation. It is available with running water cooling or with cooling unit built in with or without a hood.
Schramm, Inc, Westchester, Pa.

For more data on these items, use post cards p 167. Identify your request with item number.

Hand Pump

1244 • New hand pump reportedly can blow or suck out sludge in oil lines or can prime and test lines. Suction and pressure side of pump terminate in two absolutely tight check valves. Piston is of solid brass with neoprene ring; 8-in. barrel is of heavy gauge brass. Unit is available with or without check valves.
Hold-Tite Valve Manufacturing Co, 550 Fifth Ave, New York 36, N. Y.

Industrial Pump

1232 • New industrial pump with scoop rotor and rubber roller-type vanes is de-
(*Continued on page* 182)

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 1 | DECEMBER 1953 | Number 6

Zeolite Double Trouble Solved

A utility plant has solved a bothersome two-way problem with their base exchange water softeners. Suspended matter periodically fouled up the beds so that even after regeneration the exchangers functioned at low efficiency. In addition, tanks were corroded by the brine solution used for regeneration.

These problems were presented to the Hall field engineer in the area, and were licked when he prescribed Banox.* Both difficulties were taken care of by Banox, since it has an inhibiting action on brine corrosion, and its high activity as a dispersing agent assured clean beds each time the units were regenerated.

Other problems involving "dirty" exchangers can be solved once the facts are ascertained. Different solutions may be required, for example sterilization of the bed in a case of slime accumulation.

Paper Presented at Water Conference

B. Q. Welder, Hall engineer, presented a paper on "Gadgets" at the final session of the Fourteenth Annual Water Conference of the Engineers Society of Western Pennsylvania held in Pittsburgh on October 19, 20, 21. Co-authored by Dr. E. P. Partridge, Director of Hall Laboratories, the paper reports field observation of the performance of various devices claimed to be effective in treating water by non-chemical means. Reprints of the paper will be available after the "Proceedings of the Fourteenth Annual Water Conference" has been published.

*Banox is a registered trademark.

Stream Polution Survey Cuts Waste Disposal Costs

In order to comply with state standards, a metal-plating plant in the midwest was contemplating the construction of a waste water installation with a capacity of 1,500,000 gpd.

A detailed study of the processes employed in the plant, conducted by Hall engineers in close co-operation with plant personnel, resulted in recommendations leading to a drastic reduction in the amount of waste requiring treatment. The practical outcome—a waste water treatment plant is being built with a capacity of only 250,000 gpd, now adequate for all requirements. Additional benefits are being realized through more efficient operation and the recovery and reuse of plating materials.

The solution of the problem of waste water disposal began with a study of process water use and the development of methods for its conservation and reuse. Since this plant had time to act before the state authorities put the pressure on, a complete study was made to supply an economical and effective result.

Technical Information Program Covers 20 Years

Keeping clients informed is one of the continuing services of Hall Laboratories. During the past twenty years, reprints of nearly one hundred technical articles, papers and discussions have been sent to Hall clients all over the world. These reprints covered the latest developments in water treatment and allied fields, and ranged in subject matter from "Gaging and Sampling Water-Borne Industrial Wastes" to "Concentrating Films: Their Role in Boiler Scale and Corrosion Problems."

Some papers have been of such general interest that requests have come from many plants, not clients of Hall Laboratories, both in this country and abroad. For example requests for the paper on "Concentrating Films" have come from Canada, Venezuela, Argentina, England, Holland, India, Formosa, and the Philippines.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Don't waste it.

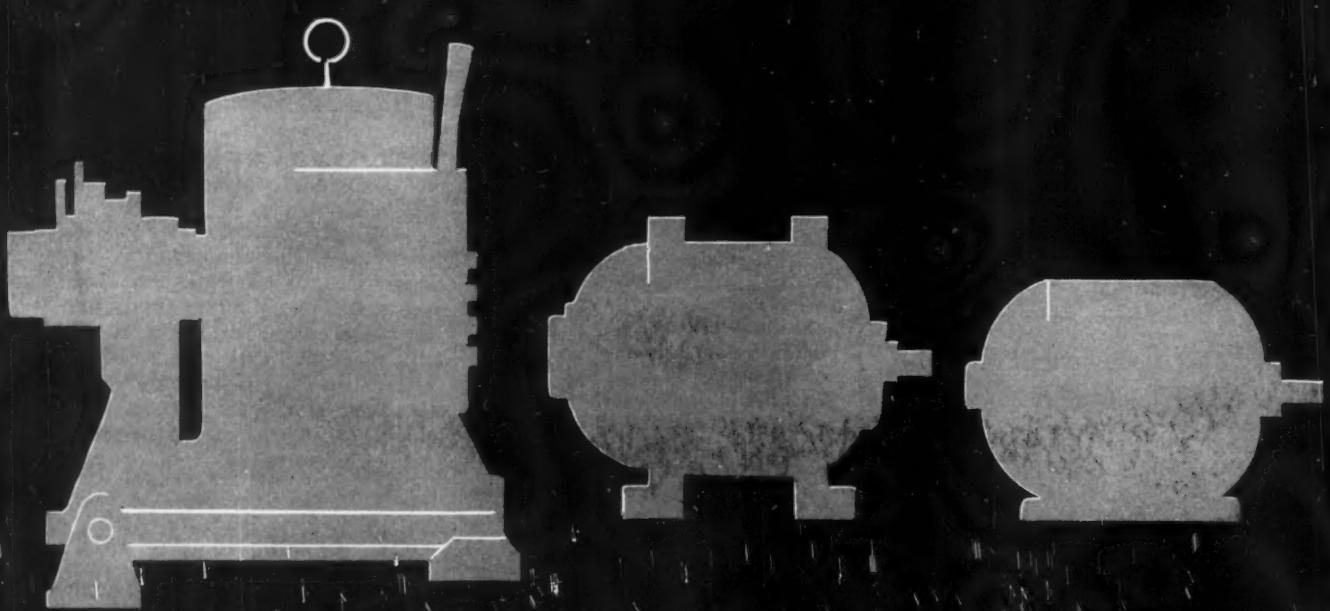
ASME Meeting in New York

Among papers to be presented at the 74th annual meeting of the ASME in New York are several sponsored by the Joint Research Committee on Boiler Feedwater Studies. Included is the paper, "Action of Boiler Water on Steel—Attack by Bonded Oxygen" by Kaufman, Trautman and Schnarrenberger of Hall Laboratories. Other papers cover corrosion by dissolved oxygen and the breakdown of amines in boiler water.

HALL LABORATORIES, INC.—CONSULTANTS ON PROCUREMENT, TREATMENT, USE AND DISPOSAL OF INDUSTRIAL WATER

(Advertisement)

WHAT'S NEW IN MOTORS



1888
TESLA
5 H.P.
765 LBS.

1926
CS
5 H.P.
130 LBS.

1947
LIFE-LINE
5 H.P.
119 LBS.

IS STILL TO COME . . .

Hear anything about a new motor? Well, if you think you have, let's set the record straight . . . What's New In Motors Is Still To Come!

Westinghouse has been a leader in the designing and manufacturing of motors for over 60 years. During these many years, over 20 million dollars has been spent on the development of basic lines of induction motors to maintain this leadership. Here are the real years of "new motors" in the parade of progress:

1888—*THE FIRST A-C MOTOR—THE WESTINGHOUSE TESLA MOTOR*

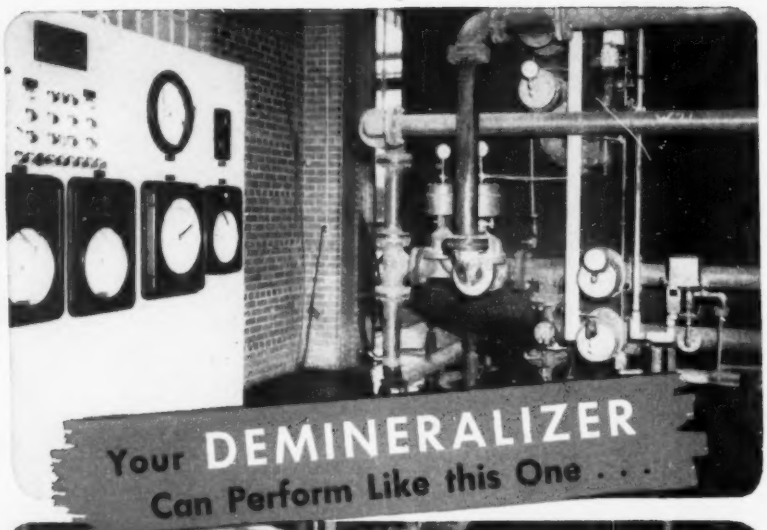
1926—*THE FIRST SEALED SLEEVE BEARINGS—THE WESTINGHOUSE CS MOTOR*

1947—*THE FIRST MOTOR WITH PRE-LUBRICATED BEARINGS PLUS A ⅓ WEIGHT AND SIZE REDUCTION—THE WESTINGHOUSE LIFE-LINE MOTOR*

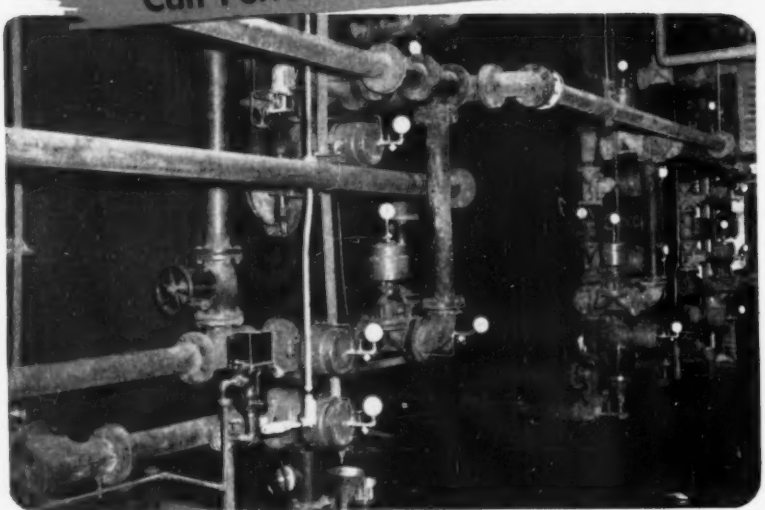
The smaller, lighter Westinghouse Life-Line Motor of 1947 was the last major contribution. *AND FOR THE NEXT ALL-IMPORTANT STEP AHEAD IN MOTOR PROGRESS . . . LOOK TO WESTINGHOUSE.*

YOU CAN BE SURE.. IF IT'S Westinghouse

J-21834



Your DEMINERALIZER
Can Perform Like this One . . .



with Nalcite (DOWEX*)

HIGH CAPACITY
HIGH TEMPERATURE
ION EXCHANGE
RESINS

500 gallons per minute of clarified Missouri River water are completely deionized for 100% make-up to a 1250 psig boiler by this Nalcite-charged unit at a large Midwestern utility. Whether your water conditioning problem is large or small, Nalcite HCR cation exchange resin, together with either Nalcite SAR or SBR anion exchanger gives you performance that means longer on-line operation, with removal of both strong and weak acids including silica.

Full information on Nalcite Ion Exchange Materials is yours for the asking. Write today.

*Reg. Trademark of the Dow Chemical Company

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

Nalco®

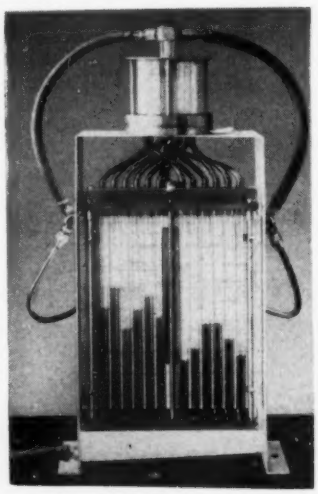
PRODUCTS • *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.*

More EQUIPMENT NEWS

Begins on page 158

signed for production in bronze to meet continuous water recirculation requirements. Model 4300 features sealed, permanently-lubricated bearings. Pressed fit of stainless steel shaft into inner ball bearing race restricts lateral movement of rotor, minimizes end-thrust wear within pump. Pump impeller, self-lubricated with water, will deliver approximately 7 gpm at 50 lb pressure and 1750 rpm. Pressure ranges from 0 to 75 psi, weight is 4½ lb, recommended speeds up to 1800 rpm.

Hypro Engrg, Inc, 404 N Washington Ave, Minneapolis 1, Minnesota



Nozzle Spray Tester

1214 • New portable device provides fast low-cost measurement of nozzle spray dispersion in jet and diesel engines. It provides immediate facilities for time and labor saving pre-installation tests to insure proper atomization, permits accurate low-cost development and production tests.

Called the *Patternator*, unit is easily portable, weighs 25 lb, measures 10x6x20 in. It requires no electric current and no installation, operates by automatically collecting and measuring flow in each segment of atomized spray. It is adjustable to nozzles of varying sizes and types.

Jet-Heet, Inc, Englewood, N. J.

For more data on these items, use post cards p 167. Identify your request with item number.

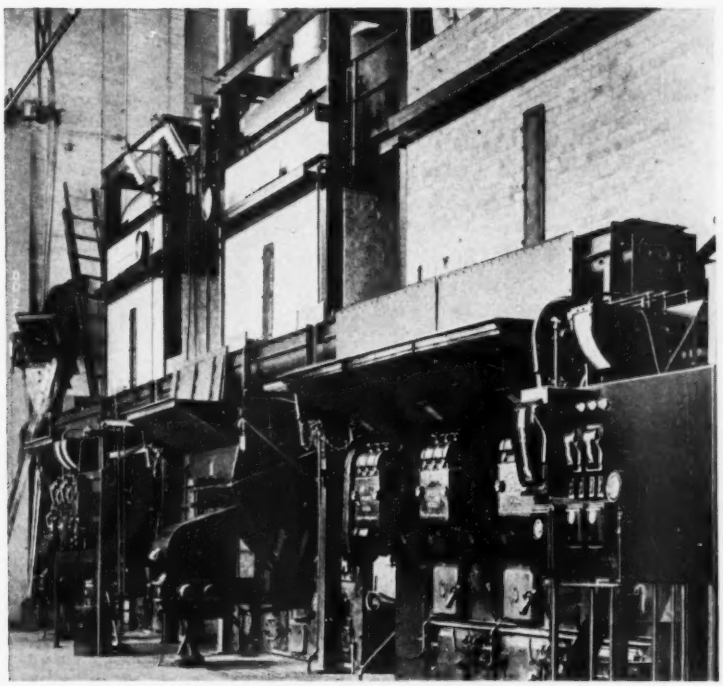
Non-Flammable Hydraulic Fluid

1254 • New non-flammable hydraulic fluid, *Houghto-Safe*, reportedly satisfies need for a safe, non-toxic, non-corrosive liquid that can be used in hydraulic equipment operated near open flames or adjacent to extreme heat conditions. Liquid is a water-base, "snuffer type" material rated as an "acceptable hydraulic fluid from the fire hazard standpoint" by Factory Mutual Engineering Division of Associated Mutual Fire Insurance Companies.

Fluid has shown lubricating abilities of high grade petroleum. It will not freeze

(*Continued on page 184*)

WHY EUCLID SWITCHED TO COAL!



"We cut costs and provided our expanding plant with a flexible heating system by burning coal instead of gas,"

says D. L. Lawrence, Plant Engineer
The Euclid Road Machinery Co.
Cleveland, Ohio

"Upon expanding our St. Clair Plant, we found we could save money by replacing our gas-fired heating system with a modern coal-burning installation. After we made this change, our plant again doubled in size. Yet the stoker-fed boilers shown on the left continued to supply all our heating needs."

Additional case histories, showing how other types of plants save money by burning coal with modern equipment, are available upon request.

What does it cost you to operate your steam plant? Chances are that, unless you've modernized in the past few years, you could reduce that cost substantially with modern, bituminous coal-burning equipment.

Modern combustion equipment can give you 10% to 40% more steam from a ton of coal. Up-to-date coal and ash handling equipment can cut your labor costs and provide you with a clean, convenient, dust-free operation.

And with bituminous coal, you will continue to enjoy these advantages for years and years.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

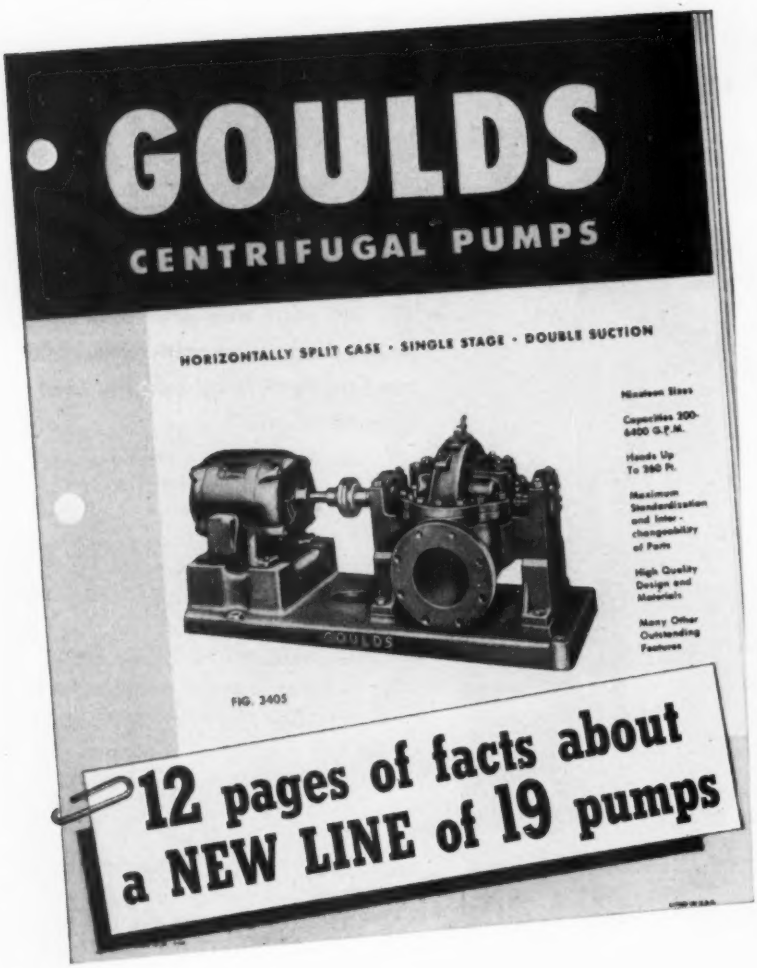
COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Southern Building, Washington 5, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!


GOULDS
CENTRIFUGAL PUMPS
HORIZONTALLY SPLIT CASE · SINGLE STAGE · DOUBLE SUCTION
Nineteen Sizes
Capacities 200-6400 G.P.M.
Heads Up To 360 Ft.
Maximum Standardization and Interchangeability of Parts
High Quality Design and Materials
Many Other Outstanding Features
FIG. 3405
12 pages of facts about a NEW LINE of 19 pumps

The quickest way you can really discover what the new Goulds Fig. 3405 centrifugal pump can do for you is to read the descriptive bulletin pictured above.

Here are some hints of what you'll find:

The quality of materials and extras of design that you have been able to get only by paying extra are *standard* on this new pump: stuffing box bushings, stainless steel impeller keys, Teflon water seal rings —to mention a few.

The Fig. 3405 carries interchangeability of parts far beyond anything we've been able to do before. Only three shaft and rotating parts assemblies (exclusive of impellers and wearing rings) provide for 19 pump sizes.

This means real spare parts inventory savings for any plant that uses many pumps. It also means easy-to-make field changes to meet new requirements.

We've come as close as modern design and materials allow to putting into this new pump what our industrial customers have told us they want. The 12-page illustrated bulletin tells you all about it. We'll be glad to send you a copy.

To get a copy of Bulletin 721.6, get in touch with the nearest Goulds representative or just fill in the coupon, pin it to your letterhead and mail it to us at your convenience.

GOULDS PUMPS, INC.
Dept. PO, Seneca Falls, N. Y.

Please send me 12-page information Bulletin No. 721.6 on the new Fig. 3405 centrifugal pump.

Name_____

Company_____

Street_____

City_____ Zone____ State_____

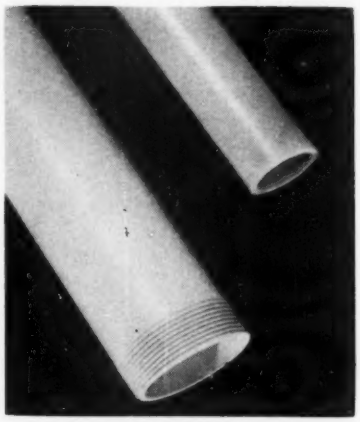
Goulds PUMPS INC. Seneca Falls New York

More EQUIPMENT NEWS

Begins on page 158

and is pumpable at working temperatures as low as 0 F. It can function efficiently at 1000 psi pump pressure and film strength tests indicate it will carry 2½ times the load of conventional fluids. Liquid will not separate or break down under increased pressures.

E F Houghton & Co, 303 W Lehigh Ave, Philadelphia 33, Pa.



Plastic Pipe

1220 • New, rigid, non-plasticized, polyvinyl chloride, plastic pipe features exceptional resistance to wide range of organic and inorganic chemicals. Relatively high structural strength and dimensional stability of new pipe together with its excellent outdoor service life and toughness make it especially suitable for applications where chemical, atmospheric and electrolytic conditions create high maintenance costs in the use of metal piping. High dielectric strength, low water absorption and non-flammability make it useful as an electrical conduit.

Weight of pipe is one-fifth that of steel; installation requires no special tools. Pipe is available in standard sizes with special wall thicknesses made to order.

Carlon Products Corp, 10225 Meech Ave, Cleveland 5, Ohio

For more data on these items, use post cards p 167. Identify your request with item number.

All Purpose Hose

1265 • New all purpose industrial hose features abrasion resistant cover that withstands sunlight and weather checking. *Vari-Purpose* hose is reinforced with rayon cord and reportedly withstands deteriorating action of oil, grease, gas, weak inorgaic acids and alkalies, etc. Sizes range from ¼ to 1½ in. with working pressures from 125 to 300 lb.

Hamilton Rubber Manuacturing Corp, Trenton 3, New Jersey

Rod Packings

1266 • New industrial rod packings of braided asbestos feature 35% *Teflon* impregnation that reportedly will provide

(*Continued on page* 190)

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Your choice for strong, leakproof piping!

This TUBE-TURN Concentric Reducer is designed with the smoothest reductions and the strongest knuckle contours consistent with adequate tangent lengths and the end-to-end dimensions established for this type fitting by the American Standard. TUBE-TURN Reducers are superior to the pipe in bursting strength and their fatigue life equals that of the butt weld used to join them to the pipe.

For piping installations that are maintenance-free and have extra long life, specify TUBE-TURN Welding Fittings and Flanges. Your nearby TUBE TURNS' Distributor is at your service with industry's most complete line.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Chicago • Denver • Los Angeles • San Francisco Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO • PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA.

ENGINEERING SERVICE

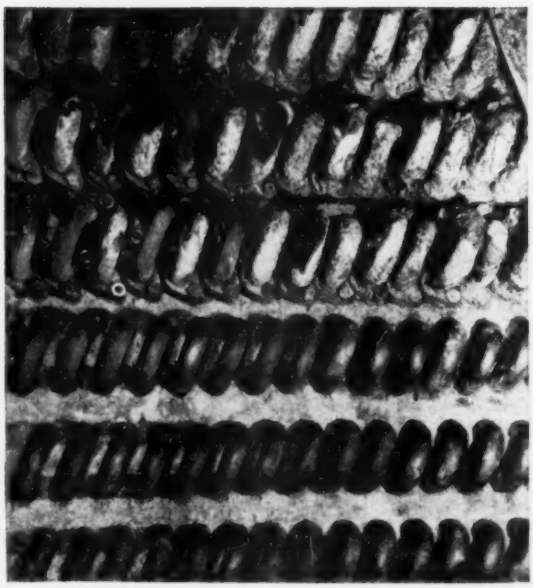
TUBE TURNS' *Engineering Service*

shows the way to eliminate equipment shutdowns

● In the past, directional changes in the tubes used in fuel economizers for boilers have been made with flanged U-bends or with header boxes. Although leakage was inevitable sooner or later, and repairs difficult, such conventional connections were necessary to permit periodic dismantling and mechanical cleaning.

Now, improved methods of water treatment have eliminated the need for such cleaning in most cases, and with it, the need for joints that can be readily disassembled. Accordingly, TUBE TURNS' Engineering Service has recommended re-fabricating tube assemblies with TUBE-TURN 180° Welding Returns, which are available in thicknesses and radii to match the tube walls and centers of most economizers.

The result has been the elimination of any leakage in economizer tubing, thus ending shutdowns of economizers, boilers, and other critical equipment. In addition, pressure drop is reduced, and flow conditions improved. When you have a tough piping problem, bring it to TUBE TURNS' Engineering Service—a service that typifies TUBE TURNS' leadership in piping engineering.

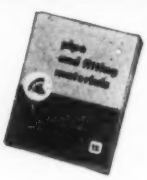


At top: flanged connections in economizer. *At bottom:* permanently leakproof, TUBE-TURN Welding Returns.

Shop fabrication of welded piping assemblies is easy, thanks to the uniform wall thickness and dimensional accuracy of TUBE-TURN Welding Fittings. Line-up is fast and accurate.

Want Piping Information?

Tube Turns, Inc. has prepared a booklet listing properties and specifications of pipe and fitting materials—carbon steels and wrought iron; stainless steels; nickel and nickel alloys, etc. Use m free engr. just email this coupon.



TUBE TURNS, INC., Dept. C-12
224 East Broadway, Louisville 1, Kentucky

Your name .....

Position .....

Company .....

Nature of business .....

Address .....

City ..... *State* .....

DISTRICT OFFICES

New York	Midland
Philadelphia	Tulsa
Pittsburgh	San Francisco
Cleveland	Los Angeles
Chicago	Seattle
Houston	Atlanta
Dallas	Denver

"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

STANDARD HD
TRADE MARK
OIL

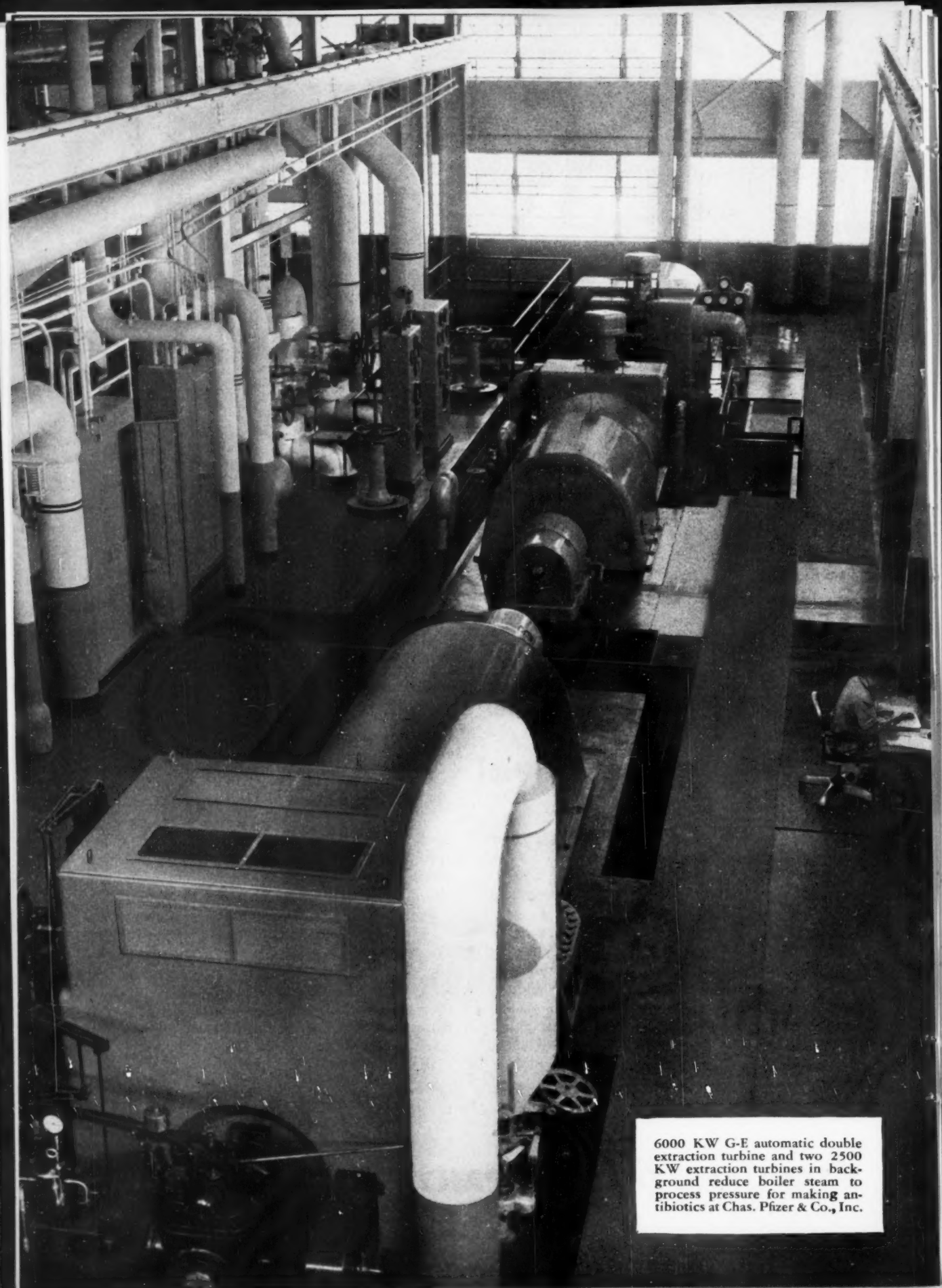
21,000 hours young!

● This 1320-hp diesel engine has provided many hours of economical service for the City of Benson, Minnesota, Water and Light Department since it was installed in October, 1948. It has been operated on an average of 20 hours each day and has generated over 13 million KW at an average load factor of 75%.

In this hard-working diesel, the lubricating performance of STANDARD HD Oil has been outstanding, particularly in view of the fact that crude oil has been used as fuel. Visual evidence of the clean, protective lubrication provided by STANDARD HD is presented in the above unretouched photograph of a piston removed from the diesel after 21,000 hours' operation. Deposits are at a minimum; rings are free. The original fill of STANDARD HD has not been changed, yet a recent examination and analysis of the oil showed it to be in excellent condition.

Diesel operators throughout the Midwest are receiving service like this from STANDARD HD Oil. The Standard Oil lubrication specialist serving in your section of the Midwest will be glad to give you information about the use of STANDARD HD in plants near your own. Just phone your local Standard Oil office. Or, write: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY STANDARD *(Indiana)*



6000 KW G-E automatic double extraction turbine and two 2500 KW extraction turbines in background reduce boiler steam to process pressure for making antibiotics at Chas. Pfizer & Co., Inc.

G-E Extraction Turbine at Chas. Pfizer & Co., Inc. Increases Plant Thermal Efficiency Over 15%

Extraction pressures held constant, even under varying loads; turbines reduce boiler steam to process pressures for use in making antibiotics

Plant thermal efficiency was increased over 15% when Chas. Pfizer & Co., Inc., producer of antibiotics, recently installed the third General Electric automatic extraction turbine-generator at its Groton, Connecticut, plant. A 6000 KW extraction unit was installed to take fullest advantage of available high-pressure steam, and to obtain additional economical by-product power.

PRESSURE HELD CONSTANT

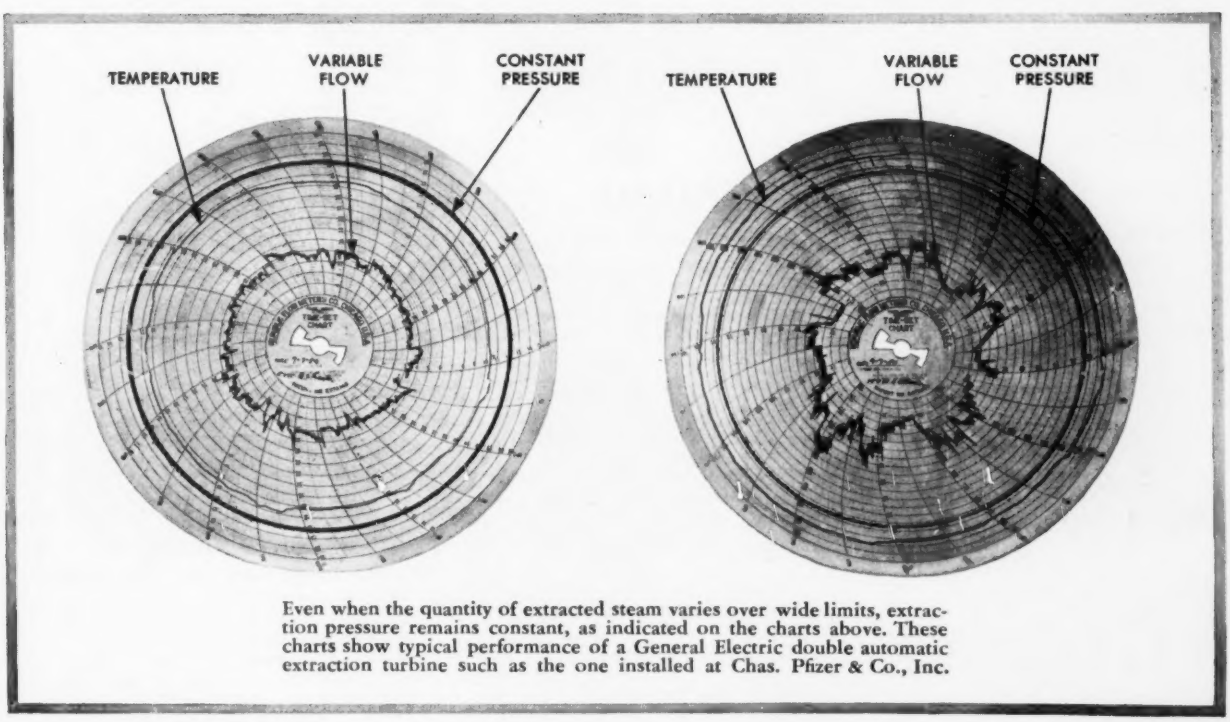
The double automatic extraction turbine takes steam at 725 F, 600 psig, and extracts at 135 and at 50 psig for plant process uses in the making of terramycin and other antibiotics. Chas. Pfizer & Co., Inc. reports that accurate turbine governing holds electrical frequency constant, and keeps extraction pressures precise, even when the quantity of extracted steam varies. (See charts below.)

If your plant uses process steam, why not take advantage of G.E.'s experienced turbine engineering resources. G-E engineers will study and recommend ways for you to best utilize steam supply. Get more for your turbine dollar with G-E turbine-generators. General Electric Company, Schenectady 5, New York. 256-8

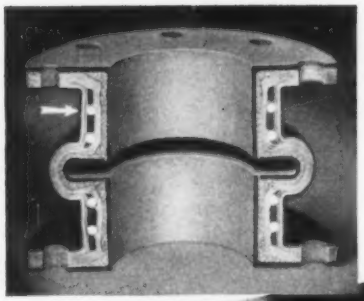
1878 75 1953 YEARS OF ELECTRICAL PROGRESS

You can put your confidence in—

GENERAL ELECTRIC

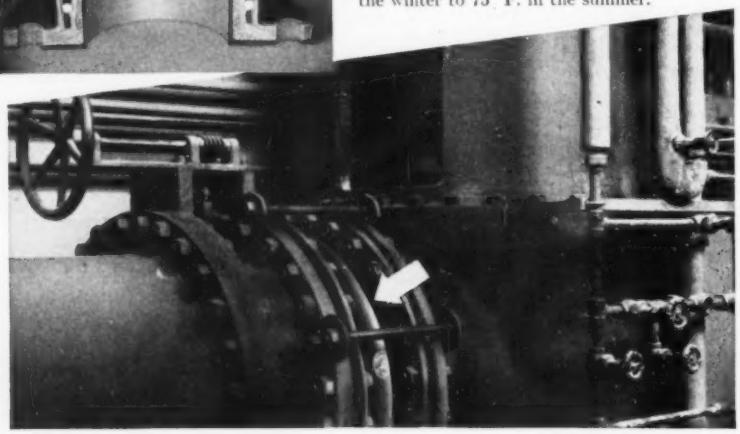


Even when the quantity of extracted steam varies over wide limits, extraction pressure remains constant, as indicated on the charts above. These charts show typical performance of a General Electric double automatic extraction turbine such as the one installed at Chas. Pfizer & Co., Inc.



LEFT: Sectional view showing sturdy construction of a Garlock single arch spool-type expansion joint. Arrow points to one of steel reinforcing rings.

BELOW: Garlock 204 spool-type rubber expansion joint installed on a 30″ pipe line connecting a propeller-type circulating water pump at the N. Y. State Electric & Gas Corp., Greenidge Station, Dresden, N. Y. The water temperature varies from 33° F. in the winter to 75° F. in the summer.



Forget about pipe line expansion and contraction due to temperature changes . . .

INSTALL GARLOCK EXPANSION JOINTS

Garlock rubber expansion joints relieve stresses and strains in pipe lines and connected equipment. These flexible joints absorb vibration and compensate for linear expansion and contraction of the line. In short, they greatly reduce maintenance costs on piping and connected equipment.

Garlock rubber expansion joints are used in central power stations, factory power plants, pumping stations, paper and pulp mills, ships, etc. They are made in all pipe sizes from ¾″ to 72″, round, rectangular, tapered, off-set, spool-type, and U-type. Neoprene expansion joints for oil service and "Teflon" expansion joints for chemical service are available.

CHECK THESE 8 ADVANTAGES:

1. Made of high-grade rubber, they do not crack or fracture under repeated flexing.
2. They do not take a permanent set.
3. For pressures up to 125 p.s.i. (depending upon size of joint); and for vacuum of 30 in. of mercury.
4. Suitable for operating temperatures up to 180° F.
5. They do not corrode or erode.
6. They are light in weight and can be installed in a limited space.
7. They require no gaskets between the flanges of the joint and the flanges of the pipe.
8. They do not induce electrolysis.

Get All the Facts. Send for Descriptive Folder No. AD137.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

Branch Offices in Most Principal Cities

GARLOCK

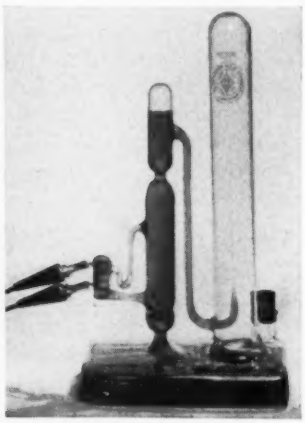
PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

More EQUIPMENT NEWS

Begins on page 158

longer service because of its resistance to acids and alkalies. Manufacturer claims it will perform satisfactorily in all temperatures ranging from –90 to 500 F. Two types are available: white for dilute acids and caustics and blue for corrosives of higher concentration.

U. S. Rubber Co, New York 20, N. Y.



Hermetically Sealed Pump

1213 • New heat-operated pump can be made entirely of glass and hermetically sealed for safe handling of dangerous or corrosive liquids. It has no moving parts except check valves, operates indefinitely and silently, according to manufacturer. Lower in efficiency than mechanical pumps, it can operate where electric or mechanical power is unavailable. Even small models can develop 25 psi and pump up to 8 gph.

Jet-Heet, Inc, Englewood, N. J.

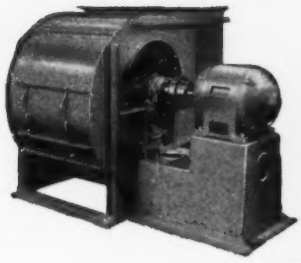
For more data on these items, use post cards p 167. Identify your request with item number.

Duplex Tubing

1239 • Duplex tubes are double walled, composed of two different metals specially designed to fight both inside and outside corrosion. In ammonia refrigeration systems, steel to ammonia side and copper or copper-base alloy to water or brine side increases heat transfer rate and extends

(*Continued on page* 194)

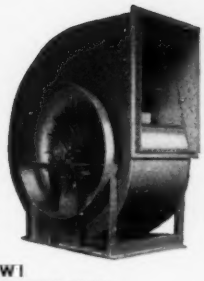
THE FAN for your JOB IS ON THIS PAGE



DRAFT FANS

"Buffalo" mechanical Draft Fans are helping turn out low-cost steam in plants and major utility stations everywhere.

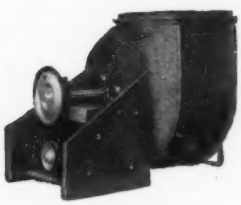
BULLETIN 3750



NEW! TYPE "BL" FANS

In sizes for 1,000 to 500,000 cfm, these new non-overloading fans for general ventilation and air conditioning offer even finer performance than their famous predecessors, the "LL" Fans.

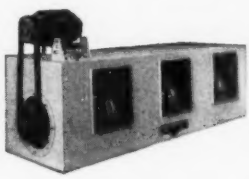
NEW BULLETIN F-100



BELTED VENT SETS

Non-overloading ventilating fans for duct or free air delivery. Extra quiet.

BULLETIN 3720



SHORTBOY VENTILATING SETS

Quiet, efficient, vibration-free fans. Wheels mounted on hollow shaft.

BULLETIN 3701

"Buffalo" Fans give "extras" in performance for two reasons: First, the line is so complete that you can pick — with mathematical accuracy — the fan to give you best possible results on almost any air moving job you could name. Second is the "Q" Factor, or inbuilt quality that "Buffalo" engineers have always insisted on. Why not have us mail you Bulletins on the right fans for your air job—from the complete line shown here?

"Buffalo" FIRST FOR FANS

. . . and for satisfaction in your PUMPING applications

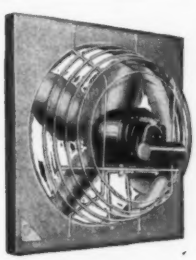
. . . check into "Buffalo" Centrifugal Pumps. Every industry depends on them. There is one to fit your hydraulic conditions. Representatives in principal cities.

BUFFALO FORGE COMPANY

485 Broadway Buffalo, N. Y.

Publishers of FAN ENGINEERING Handbook

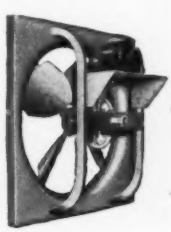
Sales Representatives in all Principal Cities



New! NV-BREEZO FANS

Their specially-shaped four-blade wheel gives high efficiency even against system pressures of ¼" and ½". 8" to 24" sizes.

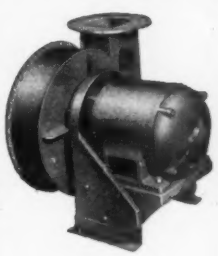
BULLETIN 3865



New! BELT-AIR FANS

Quiet, sturdy fans to move a lot of air at negligible cost. Heavy-gauge die-stamped blades and panel.

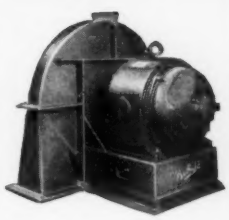
WRITE FOR BULLETIN



"CB" PRESSURE BLOWERS

Up to 2¼ psi, single stage with these husky, space-saving units!

BULLETIN 3553



"CC" PRESSURE BLOWERS

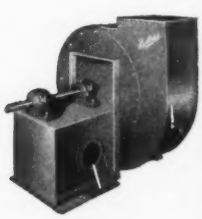
In sizes for up to 4 psi, and capacities up to 75,000 cfm. Complete range of sizes, extra heavy-duty construction.

BULLETIN 3553

AXIAL FLOW FANS

Compact, light, highly efficient ventilating fans for light duty.

BULLETIN 3533



INDUSTRIAL EXHAUSTERS

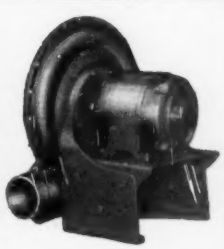
All-welded for strength and high efficiency. With air or material wheels.

BULLETIN 3576

"RE" BLOWERS - EXHAUSTERS

For pressures up to 40" of water; 50 to 1600 cfm. Furnace blowing, line boosting.

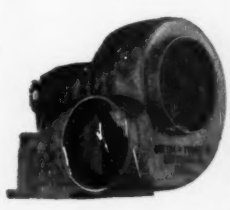
BULLETIN 3014



"E" BLOWERS - EXHAUSTERS

For low to medium pressures and volumes in draft, cleaning, line boosting.

BULLETIN 3014



BABY CONOIDAL FANS

Adjustable discharge, compact design, multi-blade rotors make these fans ideal for many small jobs.

BULLETIN 3576

VOLUME FANS

Rugged blowers-exhausters with cast iron housings and dust-proof ball bearings for any job up to 10" s.p.

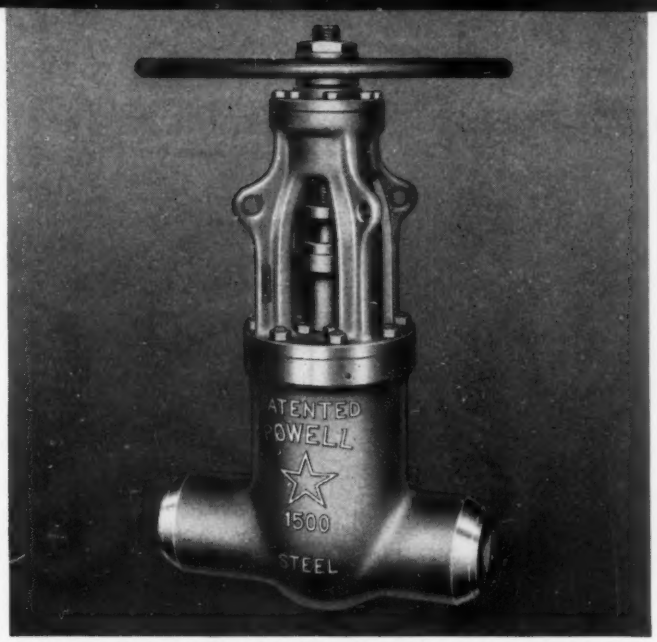
BULLETIN 3615

The Finishing Touch

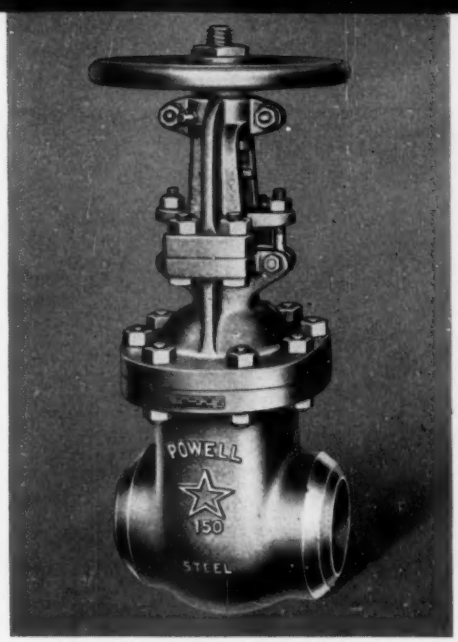
Small details can make a big difference in trimming a tree . . . and in manufacturing valves. For example, *every* Powell Valve part must pass *rigid inspection*. Then, as a final, finishing touch, each Powell Valve is subjected to *actual line tests*.

It's these seemingly small details that have helped Powell Valves maintain their record of dependability since 1846. Powell has probably done more valve research, solved more valve problems, and makes more types of valves than any other organization in the world.

With Powell Valves on the job in your plant, you'll say every day's a holiday from flow control worries. Following are just a few of the valves that have the gift of dependable service you want—and need. They're available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.



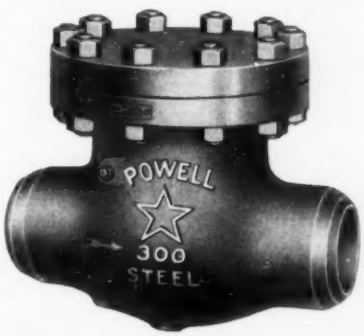
PRESSURE SEAL CAST STEEL GATE VALVE *(Fig. 11303).* 1500 pound. Many proven advantages and exclusive features. Pressure Seal Valves are also available in Non-Return, Check, Globe and Angle Patterns for 600, 900, 1500, 2500 pounds.



WELDING END CAST STEEL GATE VALVE *(Fig. 1503 W.E.).* 150 pounds. Bolted flanged bonnet with outside screw rising stem and yoke. Available in sizes 1″ to 24″, inclusive.

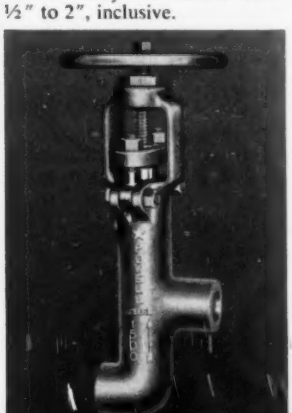
"MODEL STAR" GATE VALVE *(Fig. 1793)* for 125 pounds W.P. Iron body, bronze mounted. Supplied with taper solid wedge. Sizes 2″ to 30″, inclusive.

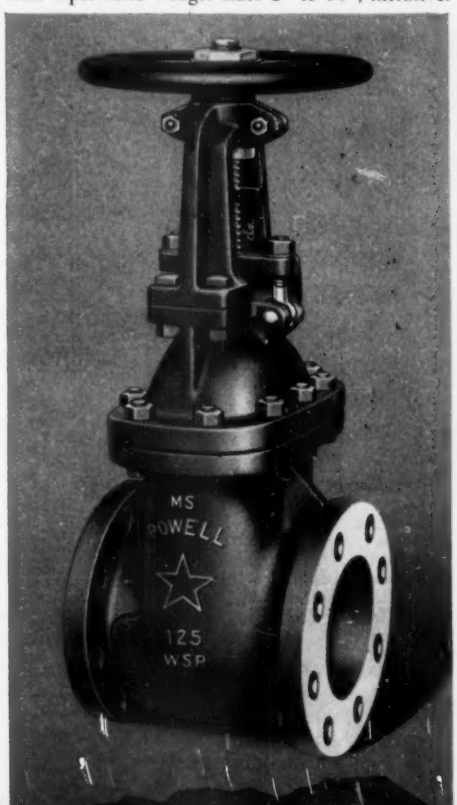
WELDING END CAST STEEL SWING CHECK VALVE *(Fig. 3061 W.E.).* 300 pounds. Bolted Flanged cap. Heavy rugged construction. Available in sizes 1″ to 12″, inclusive.



BRONZE "W.S." FULL FLOW GLOBE VALVE *(Fig. 2608)* for 200 pounds W.P. Regrindable, renewable hardened, stainless steel seat and disc. Nominal pipe size opening through seat permits fuller flow with pressure drop and turbulence cut to minimum.

INTEGRAL BONNET OFFSET GLOBE VALVE *(Fig. 1331-A).* 1500 pound. One-piece construction eliminates possibility of leakage between body and bonnet. Sizes ½″ to 2″, inclusive.

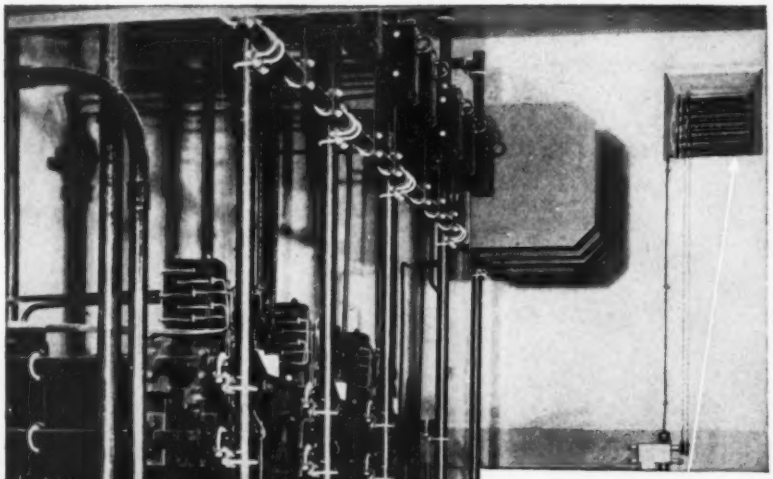




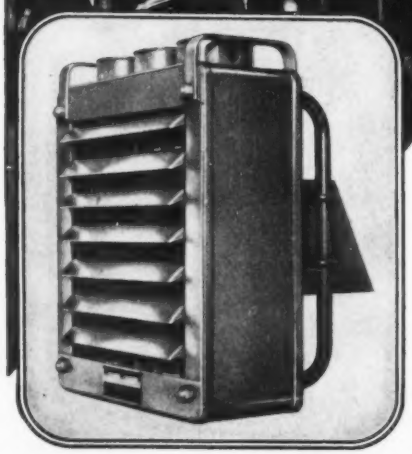
DEPENDABLE VALVES SINCE 1846

Powell Valves

THE WM. POWELL COMPANY • CINCINNATI 22, OHIO



The
WING
ELECTRIC UNIT HEATER
is ideal for locations like this——
PROTECTION AGAINST DAMPNESS AND CORROSION



Here is a familiar problem—an underground substation, unattended, where condensation is likely to occur. The simple solution of the problem is the installation of a Wing Electric Heater (shown at the upper right) which is set in operation by a dewpoint control (shown on the wall below the heater). At the first indication of excess moisture in the air, the dewpoint instrument sets the Wing Electric Heater into operation, heating and recirculating the air in the room and removing all danger of dampness and corrosion.

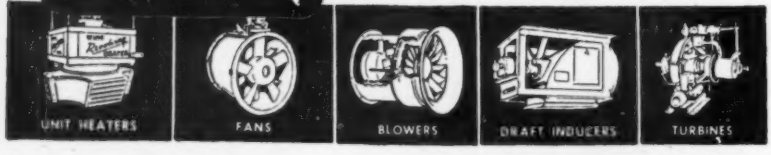
Wing Electric Heaters have many applications, not only in the electric utility field, but wherever heat is necessary at remote points or where steam or gas is unavailable or uneconomical.

The Wing Electric Unit Heater is made in three types—the Utility Heater shown above, the Wing Revolving Overhead, Downward Discharge Unit Heater and the Wing Electric Duct Heater Section. Sizes from 13,600 Btu/hr to 204,000 Btu/hr.

Write for a copy of Bulletin E-1

L. J. Wing Mfg. Co.
50 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N. J. and Montreal, Can.

Wing

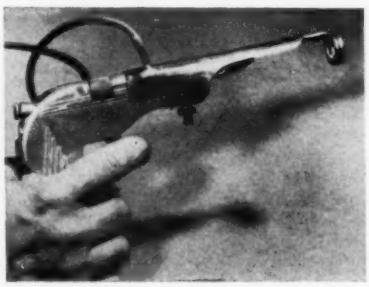


More EQUIPMENT NEWS

Begins on page 158

service life with reduced maintenance. Further details in *Duplex Tubing Tech Bulletin No. 1950.*

Bridgeport Brass Co, Bridgeport 2, Connecticut



Gas Leak Detector

1222 • Special attachment for Century *Torch-O-Matic* air-acetylene gas gun permits quick, positive and convenient detection of halogenated gases, such as refrigerants, in the air. Unit consists of gasketed metal saddle, two-turn helix of copper rod and rubber sampling tube.

By venturi effect, sampling tube draws air and mixes it with the acetylene. As the burning sample strikes the copper helix, it imparts a distinctive color according to amount of gas present. Manufacturer claims device responds to concentrations of as little as 200-ppm of halogenated gas. Further details are available upon request to manufacturer.

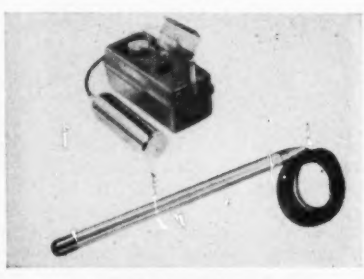
Velocity-Power Tool Co, 7500 Thomas Blvd, Pittsburgh 8, Pennsylvania

For more data on these items, use post cards p 167. Identify your request with item number.

Corona Detector

1246 • New device detects surface corona discharges that often indicate trouble or cause damage to insulation in high-voltage rotating equipment. Designed to increase safety factors by having all cable shields, metal fittings, and case at ground potentials, portable electronic detector is recommended for manufacturers of large electrical apparatus such as turbine-generators and high-voltage motors.

General Electric Co, Schenectady 5, New York



Scintillation Counters

1233 • New scintillation survey meter and scintillation drill-hole, probe-type, radioactivity detector are self-contained, battery-

(*Continued on page* 198)

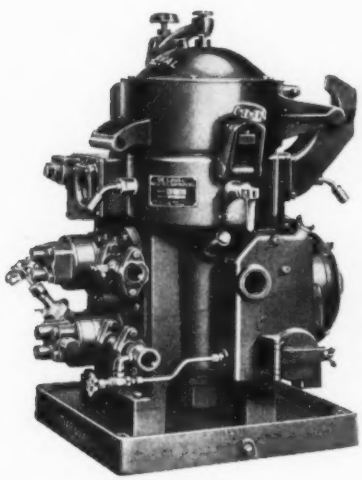
NO GETTING AROUND IT!

De Laval Oil Purifiers Give Double Protection

There's no avoiding the fact that a turbine requires protection from ***two*** troublemakers—dirt and water. Any device that removes only the dirt does only half a job.

That is why De Laval Oil Purifiers are so much more effective for maintaining the purity of turbine oil than any other means available. They not only remove solid contaminants but also any moisture that may be present.

It is important to get such ***double protection,*** for oftentimes water, rather than dirt, is the real source of contamination. For example, condensate in oil leads directly to the formation of sludge, and, of course, if a water leak should ever develop, serious emulsification and real trouble might occur.

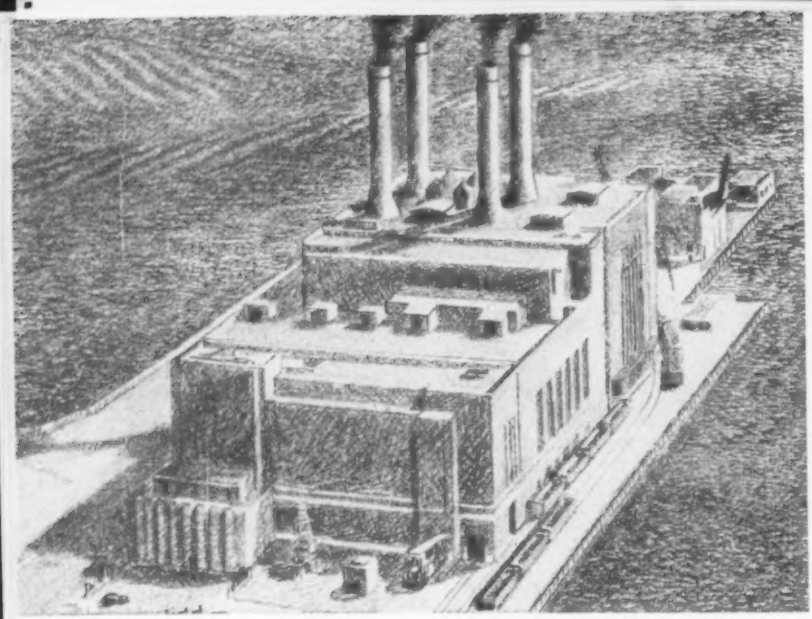


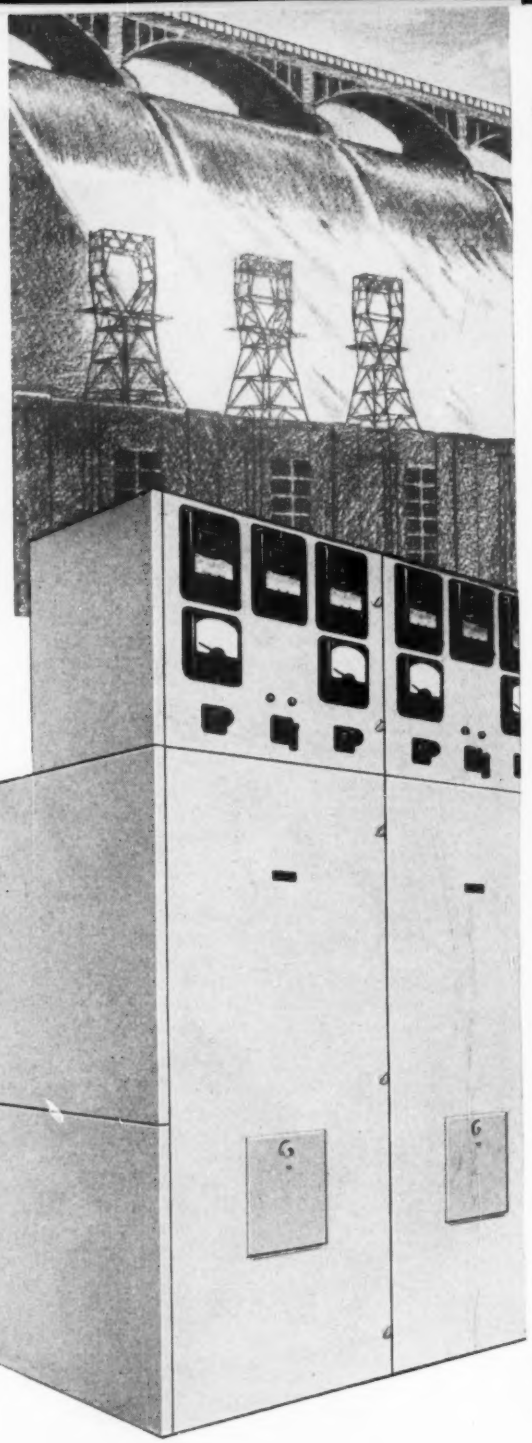
De Laval Oil Purifiers do not remove oil-soluble additives. The purifying action is entirely mechanical.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

for more dependable power production





A TRILLION KWHR by 1965*

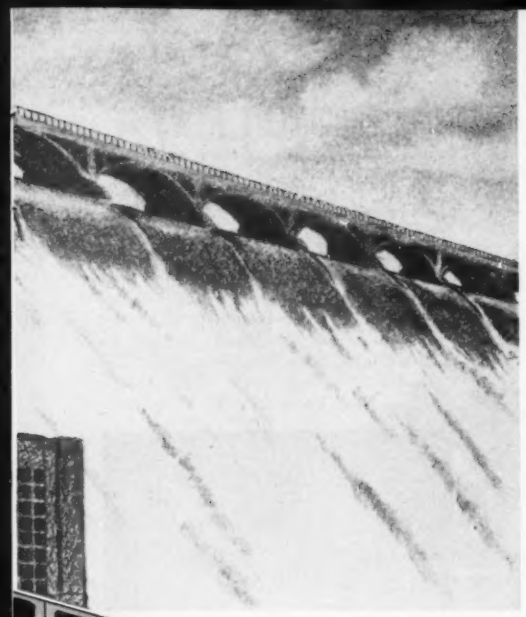
I-T-E is pacing America's greatest electrical expansion

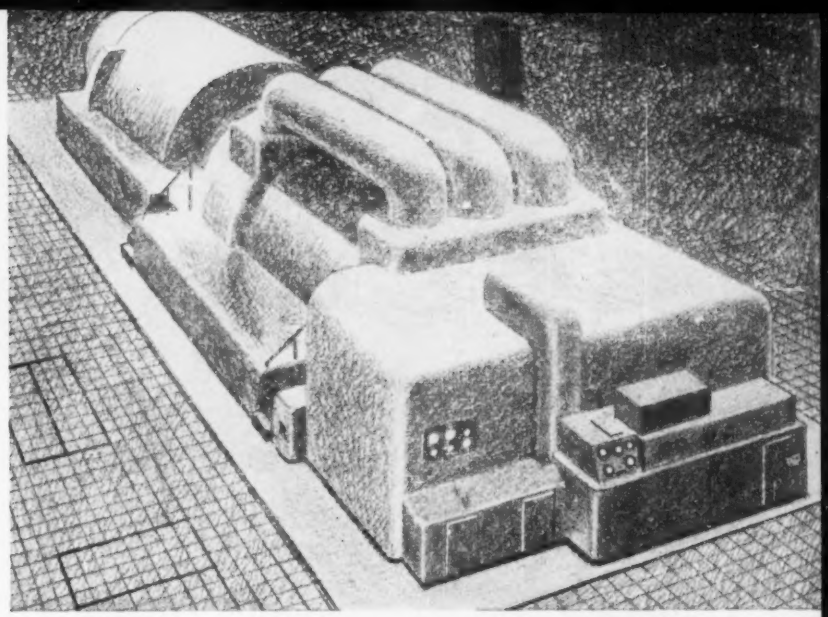
KWHR capacity has doubled in the past ten years and present trends indicate another doubling in the decade to come. New power generation, transmission, and distribution equipment—more of everything—will be required to handle this increased capacity.

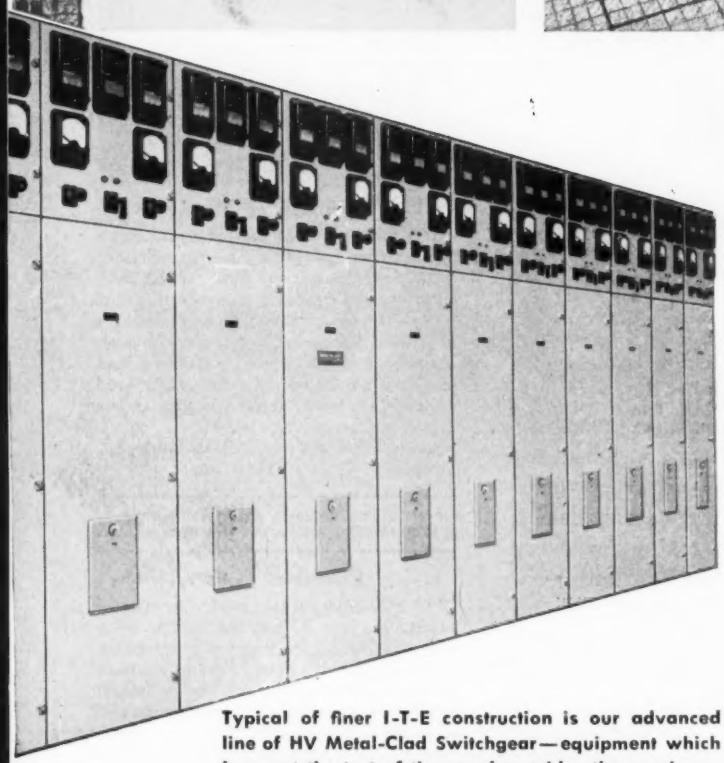
In the past ten years, I-T-E has expanded some twenty fold—supplying quality switchgear for every type of industrial and commercial application. Look for even bigger strides forward—broader lines, more products, finer designs, and increased production—as I-T-E continues to pace America's greatest electrical expansion.

**Edison Electric Institute*

THE SYMBOL OF QUALITY SWITCHGEAR







Typical of finer I-T-E construction is our advanced line of HV Metal-Clad Switchgear—equipment which has met the test of time and provides the maximum in protection and efficiency at a minimum over-all cost.

For details, call the I-T-E field office nearest you. Look in your classified telephone directory under "Electrical Equipment."

Or—write for **Bulletin No. 7004B.**

I-T-E Switchgear embodies...

- **advanced engineering**
- **refined design**
- **quality construction**

Through 65 years, the I-T-E Circuit Breaker Company has achieved outstanding recognition in the industry by persistent effort to advance the switchgear art.

Many switchgear "firsts" are attributed to I-T-E, among them:

- the original Inverse Time-Element (I-T-E) circuit breaker
- the first enclosed circuit breakers and switchboards
- the first high-voltage air magnetic circuit breaker
- the first isolated-phase bus

In addition to the introduction of new ideas and thinking, I-T-E has devoted its engineering skill to accomplishing the ultimate in design and production refinement.

I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.

I-T-E Metal-Clad Switchgear

You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in make-up or cooling water.

CD-37

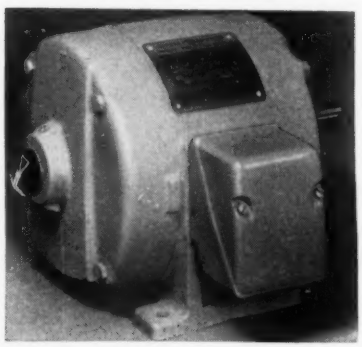
WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

More EQUIPMENT NEWS

Begins on page 158

operated counters for detecting and measuring radioactivity. Instruments are gamma sensitive and approximately 100 times more sensitive than average Geiger counter, manufacturer claims. Survey meter can be used to detect alpha and beta activity when used with appropriate phosphors. Further details available from manufacturer.

Radiac Co, Inc, 489 Fifth Ave, New York 17, N. Y.



Polyphase ac Motors

1211 • New line of polyphase ac motors offers better protection, higher efficiency and quieter operation. Built to NEMA's latest standard frame dimensions, units feature entirely new and advance concepts of motor design, according to manufacturer. Major part of design involves lowering and frequency alteration of sound. Noise level of new 10-hp motor reportedly tests as low as former 2-hp model.

General Electric Co, Schenectady 5, New York

For more data on these items, use post cards p 167. Identify your request with item number.

Portable Tester

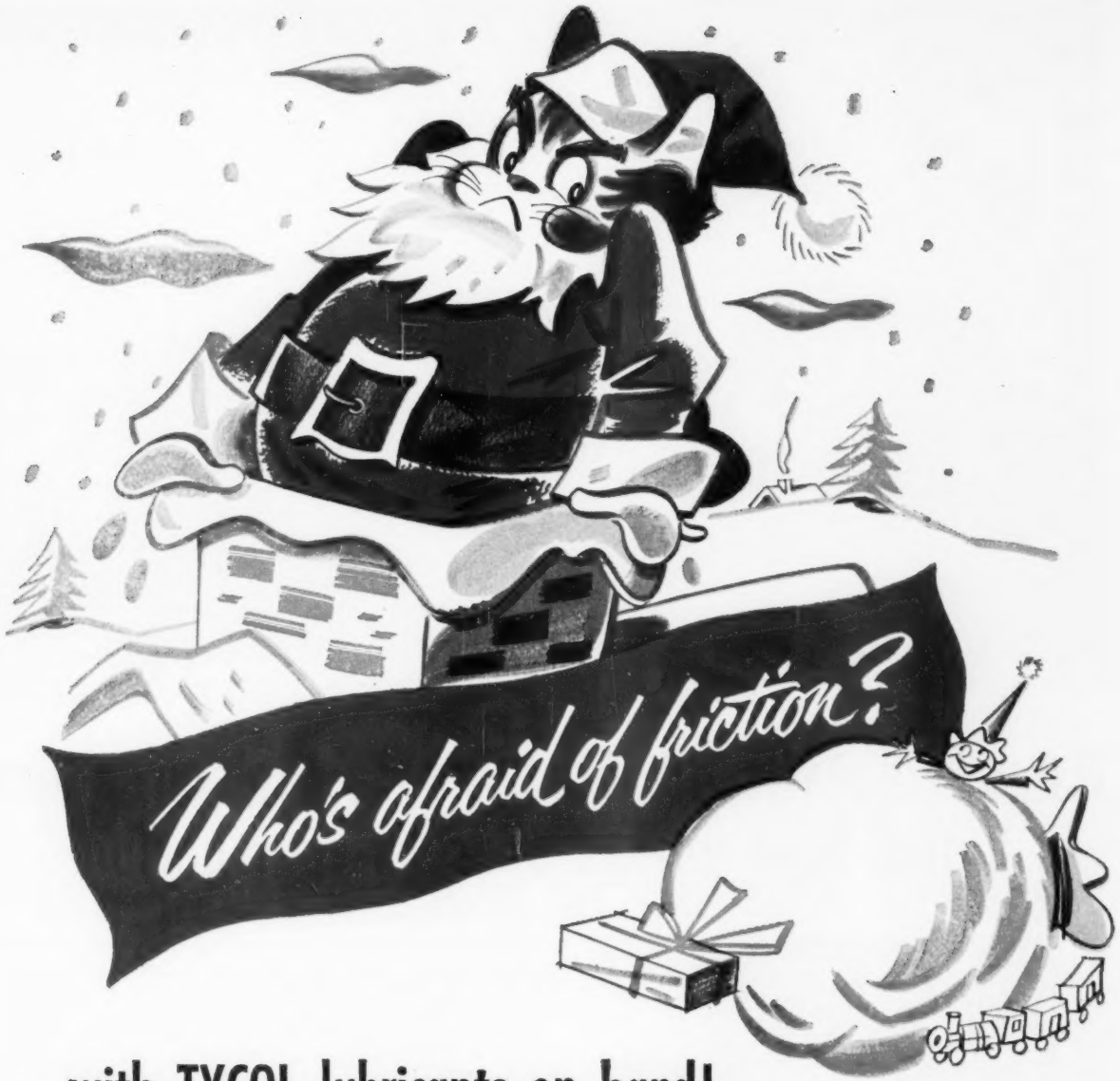
1243 • Unique loading device, accurately adjustable in stepless increments with fingertip control, is reportedly extremely safe and simple to operate. *Multi-Amp* tests current-actuated devices and can be instrumental in reducing electrical equipment and power failures, in minimizing plant downtime and in assuring maximum operating efficiency of electrical equipment. New model, ‡1005/336 includes ammeter that covers entire output range of *Multi-Amp* in six stages: 0 to 10, 25, 100, 250, 500, and 1000 a.

Multi-Amp Corp, Harrison, N. J.

Temperature Controller

1259 • New electronic temperature controller with increased range— –100 F to 600 F—employs resistance thermometer principle to provide precise and consistent control. Manufacturer claims unit is unusually flexible in type of control provided with a singel-point model. In addition to single-point model, controller is also available in cascade control models. Both models are available in three ranges: –20 to 220 F; –20 to 300 F; –100 to 600 F. Sen-

(*Continued on page* 202)



...with TYCOL lubricants on hand!

It pays to buy a "Diesel-Designed" Lubricant! ... It takes "something more than a motor oil" to counteract excessive wear in Diesel engines – and we proved it with Tycol Adeltran 40! In this instance, a Diesel engine was operated for one year with a competitive oil. An overhaul by the manufacturer turned up these conditions: all liners had to be replaced as well as piston rings ... 2 top compression rings were stuck and all rings were gummed up. After the switch to Adeltran (for the same operating period) liner wear was negligible ... filter life was considerably extended ... all rings were free and in excellent condition ... and owner reported an exceptionally clean engine base. For full details on Adeltran, contact your local Tide Water Associated office!

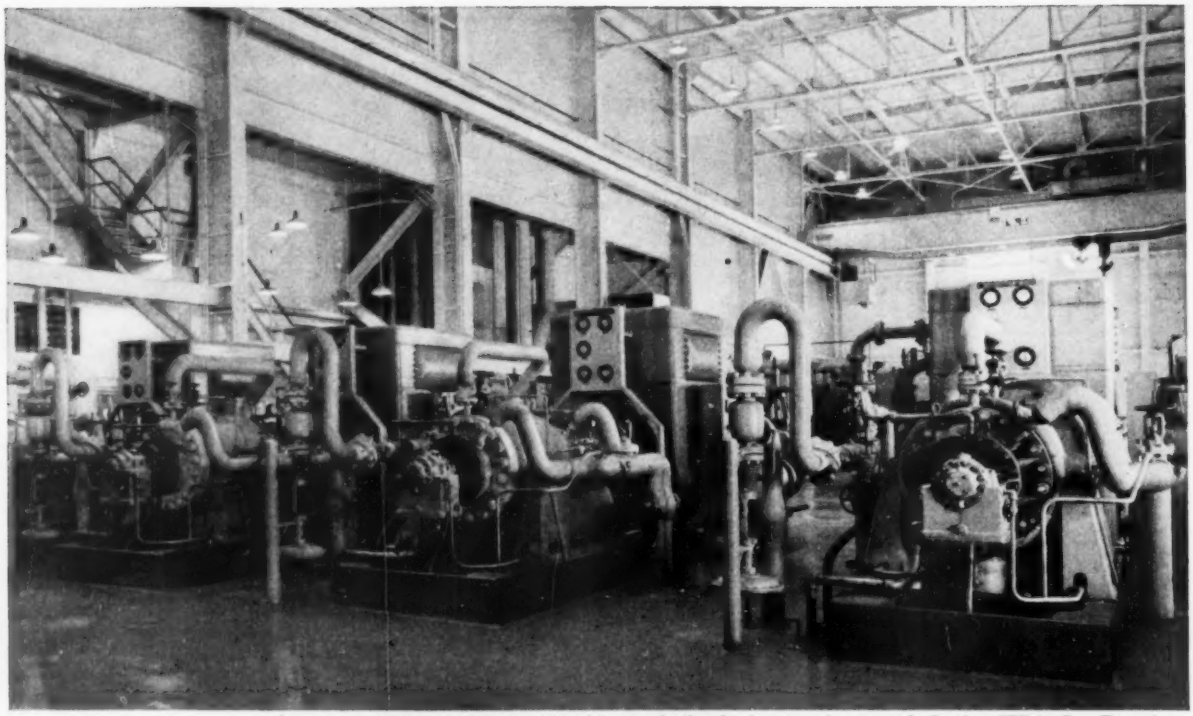
TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh
Philadelphia • Chicago • Detroit
Tulsa • Cleveland • San Francisco
Toronto, Canada

Over 300 Tycol industrial lubricants are at your disposal ... engineered to fit the job!

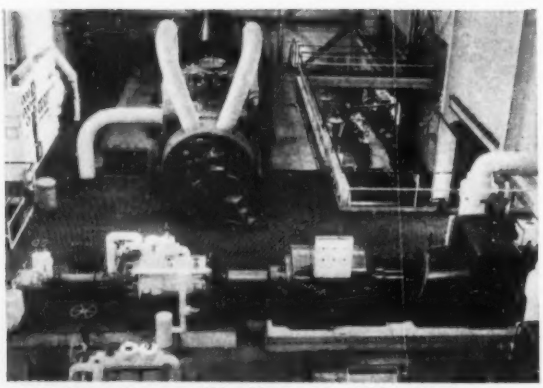
TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL... THE WORLD'S MOST FAMOUS MOTOR OIL



FOUR OF THE FIVE Worthington boiler feed pumps in P.G.&E.'s Station "P" in San Francisco. Each of the pumps shown here delivers 1,340 gpm against a discharge pressure of 1,868 psig.

P.G.&E. installs 45 Worthington high pressure boiler feed pumps over 15-year period



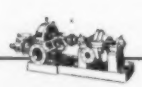
LOOKING DOWN on a Worthington 6" WCS boiler feed pump at the Oleum Station of P.G.&E.

• Pacific Gas and Electric Company, with 3,540,200 kw installed capacity, serves 5½ million people in 46 of California's 58 counties. It's been building new generating plants right and left to keep up with the power needs of this booming area.

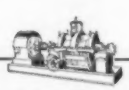
P.G.&E. is a satisfied Worthington customer. Since 1938 a total of 40 high-pressure boiler feed pumps have gone to work in seven different stations of the P.G.&E. network — proof that they do a real job for this West Coast utility. And five more of these sturdy Worthington pumps are being built for P.G.&E. right now, all designed to handle pressures over 1850 psig. This is also evidence that Worthington's design and engineering techniques are keeping right up with the greater capacities and pressures of today's steam generating units.

You can put this extensive experience in pump design and manufacture to work in your plant. For details, check with your Worthington district office or write for Bulletin W319B-1C to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

C.3.6

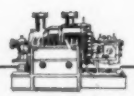


For Boiler Feed Service. Capacities to 1,500 GPM; Heads to 1,000 feet.



For Hotwell, Condensate, Chilled Water Service. Capacities to 1,400 GPM; Heads to 650 feet.

For Water Works, Circulation, Drainage, General Service. Capacities to 135,000 GPM; Heads to 400 feet.

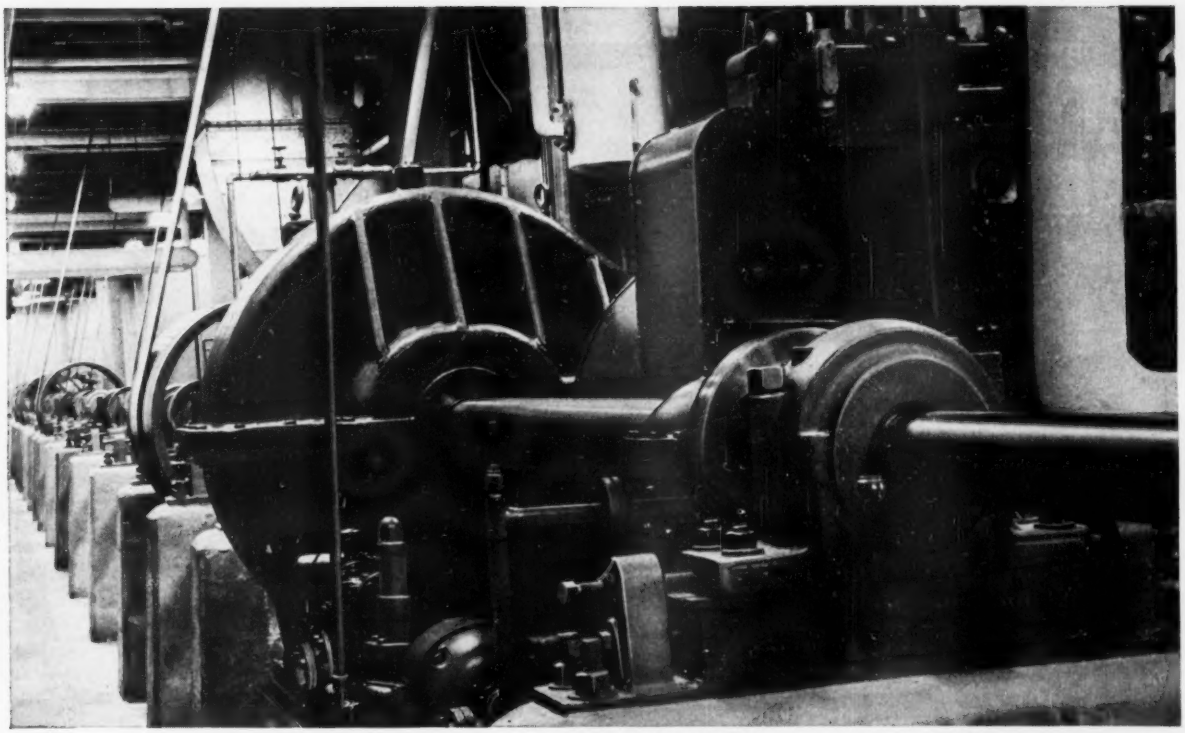


For Boiler Feed Service. Capacities to 3,000 GPM; Heads to 7,000 feet.

WORTHINGTON

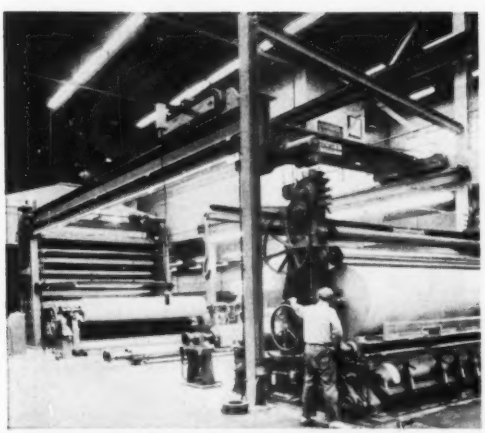
Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job



SMOOTH, STEADY SPEEDS are assured by this 1000-hp Worthington geared turbine driving the line shaft of Nekoosa-Edwards' new paper machine.

1000-hp Worthington steam turbine drives new paper machine at Nekoosa-Edwards



A SINGLE WORTHINGTON STEAM TURBINE drives this huge paper machine at Nekoosa-Edwards.

• Making high-grade specialty and printing papers is exacting precision work—with smooth, steady paper-machine speed the main requirement. That's why, when the Nekoosa-Edwards Paper Co., Nekoosa, Wisc., installed their new Puseyjones 180" Fourdrinier recently, a Worthington 1000-hp steam turbine and reduction gear were selected to drive the lineshaft.

The turbine's sensitive governor holds speed to within 1/10 of 1% above or below the governor setting, regardless of normal steam or load changes. Speed range is from 200-1200 ft. per minute, suitable for every paper run. Remote push-button control saves labor, minimizes routine attention.

The new Worthington turbine has fully automatic nozzle valve control that assures economical operation at all times. And there's plenty of reserve power in the turbine to handle future additional load requirements. No steam is wasted, either; 50 psi exhaust goes to the plant's process equipment.

Driving paper machines is only one of the many applications of the versatile steam turbine. Get the facts on the way a Worthington steam turbine can solve your drive problems, too. Write to Worthington Corporation, Steam Turbine Division, Section T.3.9, Wellsville, New York.

T.3.9

WORTHINGTON

Single-stage turbines | **Multi-stage turbines** | **Turbine-generator sets** | **Feed water heaters** | **Boiler feed pumps** | **Surface condensers**

1 Stainless steel bolts and nuts. 2 Two-piece gland and follower.
3 Bolted bonnet. 4 Tongue and groove joint.
5 Hardened wedge, chrome plated.

Why Gas Absorption Plant Chose These R-P&C Valves

● Because of the plant's isolated location the engineers felt they should standardize on a type of valve which could be used on different lines even though chemical solutions, temperatures, and pressures varied. The No. 6056 R-P&C Forged Steel Gate Valve proved to be the answer for several reasons.

First of all it has a pressure range from 380 lbs. at 1000° F., up to 2000 lbs. at 100° F. Then with its chrome stainless trim and chromium plated disc, it has high resistance to corrosion. On top of this, it's easy to service with its stainless steel gland bolts, and two-piece gland and follower.

Best of all, although the R-P&C Forged Steel Valve is premium quality it is NOT premium priced. It comes in sizes from ¼" to 2" with screwed or welding ends. If you use valves in these sizes, see your R-P&C distributor today or write our Reading, Pa., office for literature.

ACCO
R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE
TRADE MARK
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

More EQUIPMENT NEWS

Begins on page 158

sitivity for the first two ranges is ±0.1 F, for the third, ±0.9 F. Further details from manufacturer.

Minneapolis-Honeywell Regulator Co, 4494 Wayne Ave, Philadelphia 44, Pa.

Unit Connector

1219 • New corrosion-resistant, parallel groove connector for electrical transmission lines can be installed as a unit thus eliminating disassembly step during installation. Specially shaped contact faces reportedly accommodate well over 100 combinations of copper, aluminum or ACSR conductor diameters from #6 to 4/0 A. W. G. For high conductivity, manufacturer recommends coating conductors with oxide-inhibitors before installing connectors.

Thomas & Betts Co, Inc, Elizabeth, New Jersey

For more data on these items, use post cards p 167. Identify your request with item number.

"Thru-Type" Transformer

1247 • New current transformer for indoor or outdoor service is molded in thermosetting resin that serves as insulation, support and casing. Manufacturer claims construction has inherent toughness that promotes long life and is highly weather resistant. Elliptically shaped window, 1⅜ x 2¾ in., easily accommodates two 500-MCM stranded conductors with 600-v insulation. Unit can be mounted in vertical, horizontal or inverted position and its base can be rotated 90 degrees.

Allis-Chalmers Mfg Co, Miwaukee 1, Wisconsin

Motor-Generator Conversion Unit

1251 • Compact motor-generator unit converts 60 cycles to 400 cycles yet has "No-Brush" construction. Manufacturer claims this construction permits long-life, durability and reduced maintenance. Outputs of 150 va to 25 kva, single or 3-phase, are available with motor drive for any standard frequency or voltage. Vertical, two-bearing unit, available in many sizes in this range, takes little more room than conventional motor alone.

Georator Corp, Manassas, Virginia

(*Continued on page* 208)

More Hydro Power from Osage

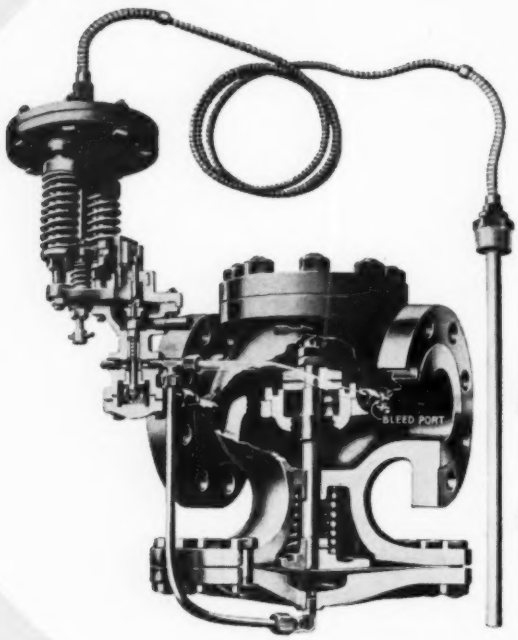
The design and construction of the initial installation of the Osage Hydroelectric Development, comprising six units of 23,887 kva each, was completed by Stone & Webster Engineering Corporation in 1931.

To provide additional power to meet the system's growing requirements, and following an engineering analysis by the engineers of Union Electric Company of Missouri, decision was reached in 1951 to employ Stone & Webster Engineering Corporation to install two additional units of 23,887 kva each, bringing the total capacity of Osage to 191,096 kva.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

3 Reasons for Accurate Regulation



PACKLESS CONSTRUCTION

LARGE BALANCED METAL DIAPHRAGM

SENSITIVE PILOT

Spence

Packless construction eliminates the need for closely fitted parts that may stick or bind due to dirt or uneven expansion of the parts.

In Spence Temperature Regulators, the Main Valve is actuated by a large balanced metal diaphragm which responds to the slightest changes in temperature.

Sensitive Pilots are designed to limit heater pressure to an adjustable maximum. As the temperature at the thermostat drops a few degrees there is a corresponding increase in steam pressure up to the limit for which the Pilot is set.

With regulators that respond only to temperature, an increase in load is accompanied by a momentary decrease in steam pressure caused by faster condensation in the heating element. There is a time lag until the thermostat senses the temperature drop and opens the valve wider. Spence Temperature Regulators act like pilot operated pressure regulators when this occurs. They respond instantly to maintain the steam pressure until the thermostat has a chance to further increase it as needed for the heavier load.

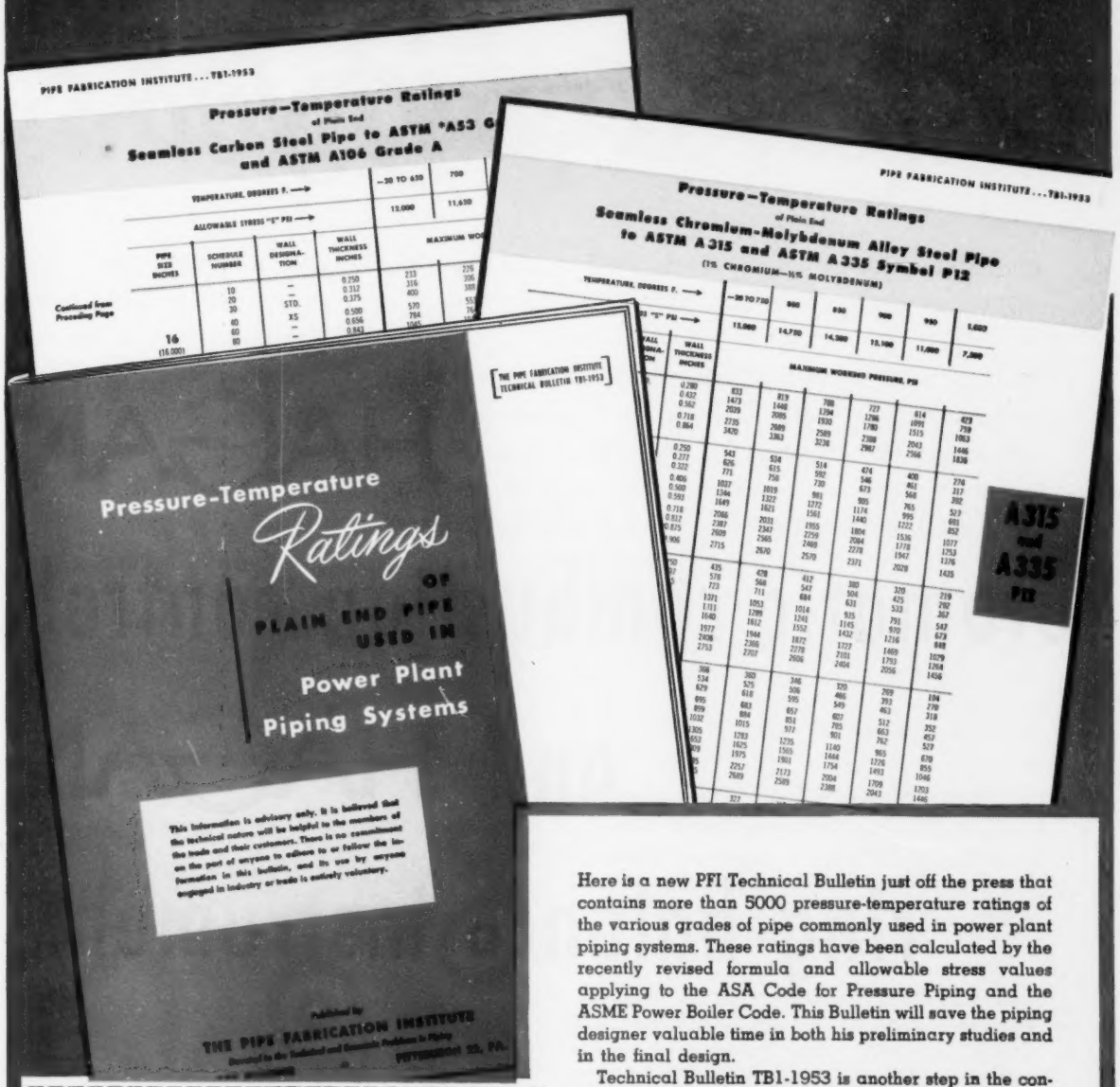
These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.

SE120

SPENCE ENGINEERING COMPANY, INC., Walden, New York

This new PFI Technical Bulletin Saves Time in Piping Design


PIPE FABRICATION INSTITUTE . . . TB1-1953
Pressure–Temperature Ratings
of Plain End
Seamless Carbon Steel Pipe to ASTM *A53 G
and ASTM A106 Grade A
Pressure–Temperature Ratings
of Plain End
Seamless Chromium–Molybdenum Alloy Steel Pipe
to ASTM A 315 and ASTM A 335 Symbol P12
(1¼ CHROMIUM—½% MOLYBDENUM)
A315 and A335 P12
THE PIPE FABRICATION INSTITUTE
TECHNICAL BULLETIN TB1-1953
Pressure-Temperature
Ratings
OF
PLAIN END PIPE
USED IN
Power Plant
Piping Systems
This information is advisory only. It is believed that the technical nature will be helpful to the members of the trade and their customers. There is no commitment on the part of anyone to adhere to or follow the information in this bulletin, and its use by anyone engaged in industry or trade is entirely voluntary.
Published by
THE PIPE FABRICATION INSTITUTE
PITTSBURGH 22, PA.

Here is a new PFI Technical Bulletin just off the press that contains more than 5000 pressure-temperature ratings of the various grades of pipe commonly used in power plant piping systems. These ratings have been calculated by the recently revised formula and allowable stress values applying to the ASA Code for Pressure Piping and the ASME Power Boiler Code. This Bulletin will save the piping designer valuable time in both his preliminary studies and in the final design.

Technical Bulletin TB1-1953 is another step in the continuing program of the PFI to be helpful to designers, fabricators, contractors and users of pressure piping. If you want a copy of this bulletin without cost, fill in the coupon at left or write on your company letterhead.

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

813 CLARK BUILDING • PITTSBURGH 22, PA.

6590

The Pipe Fabrication Institute
813 Clark Bldg., Pittsburgh 22, Pa.

Please send me without cost PFI Technical Bulletin TB1-1953 illustrated here.

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Title_____

Company_____

Address_____

Doing a big job...

HAGAN

automatic combustion controls

and HAGAN

ring balance instruments

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
AERONAUTICAL TESTING FACILITIES

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and doing it right

This simply means that the Hagan Combustion Control and Instrumentation System is maintaining optimum steam plant operating efficiency, with a minimum of operator attention and minimum maintenance costs.

That Hagan Systems are "Doing It Right" is amply demonstrated by their use in steam plants of all sizes and types, all over the world. Further proof of top performance can be found in the number of Hagan-equipped plants where the operators have repeatedly specified Hagan equipment for plant expansion or new facilities.

This record of enthusiastic approval of Hagan systems is traceable to the three basic considerations which govern the design of every Hagan system . . .

accuracy

. . . every unit used in a Hagan Combustion Control and Instrumentation System is designed for the highest possible accuracy, and is selected primarily to be an integrated part of a system built for a specific set of operating conditions.

dependability

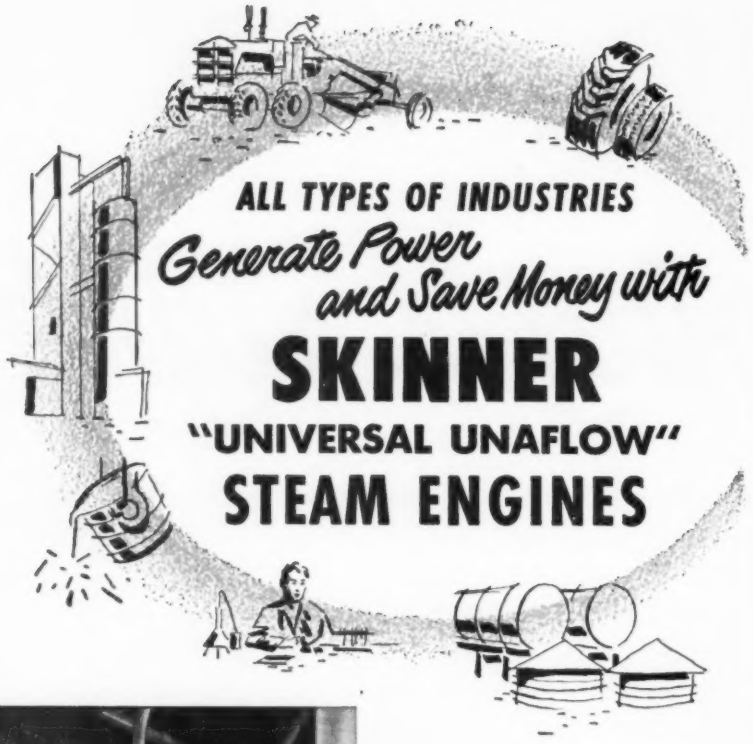
. . . sound design and sturdy construction guarantee dependability in Hagan Systems. Many plants, originally equipped by Hagan twenty or thirty years ago, are still operating efficiently with the same durable Hagan Automatic Combustion Controls.

versatility

. . . Hagan has kept pace with the new demands being made on boilers—higher temperatures and pressures, multiple fuel systems, widely fluctuating demand. Whatever the requirements of your plant, there is a Hagan System of Automatic Combustion Control and Instrumentation to fit.

HAGAN CORPORATION

Hagan Building Pittsburgh 30, Pennsylvania



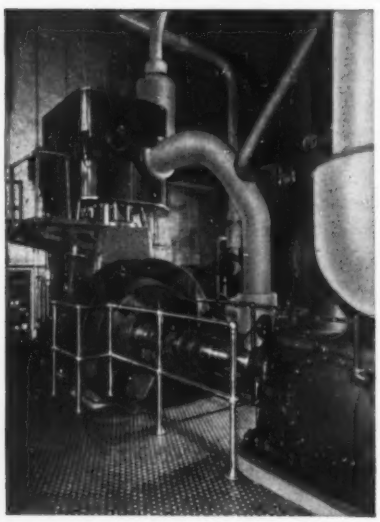
ALL TYPES OF INDUSTRIES

Generate Power and Save Money with

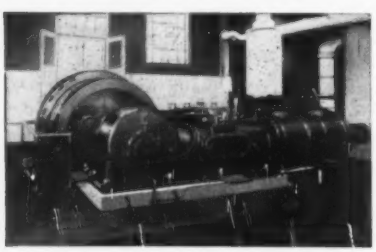
SKINNER

"UNIVERSAL UNAFLOW"

STEAM ENGINES



Two-cylinder "Universal Unaflow" driving ammonia compressor, in Brewery Power Plant.



300-Kilowatt Horizonal "Universal Unaflow" in Meat Packing Plant.

RUN down the list of American industries which are depending on Skinner Engines for unfailing, dependable power . . . to generate electricity . . . to drive compressors and pumps . . . for refrigeration and air conditioning. They have low-pressure steam as a by-product, for space heating and for use in varied manufacturing processes.

This list includes Agricultural Implement Manufacturers, Chemical Plants, Cotton Oil Producers, Electrical Appliance Manufacturers, Forging Plants, Foundries, Gas Companies, Glass Manufacturers, Machine Tool Builders, Oil Refineries, Potteries, Rubber Manufacturers, Steel Companies, Textile Mills, and Woodworking and Furniture Plants.

Among these and many other classes of money-saving users of Skinner "Universal Unaflow" Steam Engines are some who had power problems similar to yours . . . and solved them with a Skinner installation.

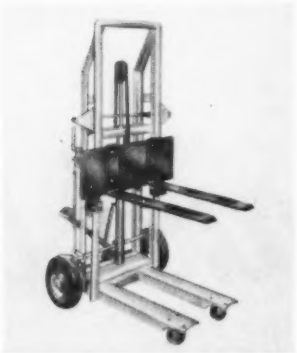
Write for literature and data regarding what has been accomplished under your conditions.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

More EQUIPMENT NEWS

Begins on page 158



Hand-Model Lift Truck

1223 • New portable lift truck features one-man operation and will reportedly lift 1000 lb to a height of 53 in. easily and safely. Unit will operate in narrow aisles and will turn easily in close quarters. Combination *snap-on* plate permits use as platform truck when forks are not required. Further details may be obtained from manufacturer.

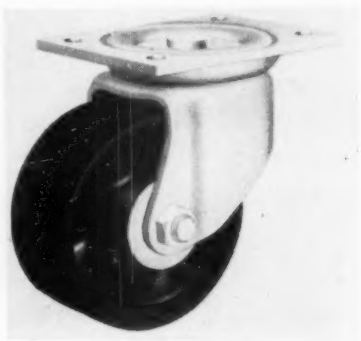
Safeway Industrial Equipment Corp, 184 N Franklin St, Chicago 6, Illinois

For more data on these items, use post cards p 167. Identify your request with item number.

Concrete Sealer

1250 • New, easy-to-apply sealer for new or used concrete floors acts as protective coating to prevent dusting and spalling. Sealer permits residual moisture to rise out of new concrete so that floor can be used sooner. Manufacturer claims sealer can be applied without prior acid treatments and that single coat is sufficient. One gallon of product covers from 400 to 600 sq ft.

West Disinfecting Co, Long Island City, New York



Steel Caster

1237 • New heavy-duty steel caster features low cost plus unusually strong construction. Product is designed to take punishing loads of powered assembly line dollies, heavy trucks and similar equipment. Caster has double ball-bearing race for quiet easy swivelling. Available in 5, 6, 8 and 10-in. sizes with semi-steel, forged-steel or rubber-tread wheels, new unit has load

(*Continued on page* 212)

Are You Putting Up This Sign Too Often?

Putting this sign up *just once* is too often.

Most of the time it means a costly shut-down, idle workmen, delayed production, very often caused by the failure of such a low-cost, but extremely vital item as portable cords. U. S. Rubber scientists have engineered U. S. Royal Portable Cords and Cables to give the longest possible life and durability. The flexible conductors are insulated with a high-grade rubber compound, and the conductor assembly is protected by 60% Neoprene jacket vulcanized in lead — thereby assuring maximum density and ruggedness. Rubber fillers are used in all portable cables, and also in the larger sizes of the portable cords. In all cases, the Neoprene jacket is reinforced internally with a strong fibrous braid.

U. S. Royal Portable Cords and Cables have extra efficiency and strength that make them ideal for use on portable electric machinery, tools, lamps, electric sanders and polishers, railroad equipment, and wherever a tough flexible cord is required.

Remember that United States Rubber Company is the only manufacturer of electrical wire and cable to grow its own natural rubber and make its own synthetic rubber and plastics. That's why "U. S." gives you a quality controlled product. Write to address below for your free copy of our general catalog on electrical wires and cables.

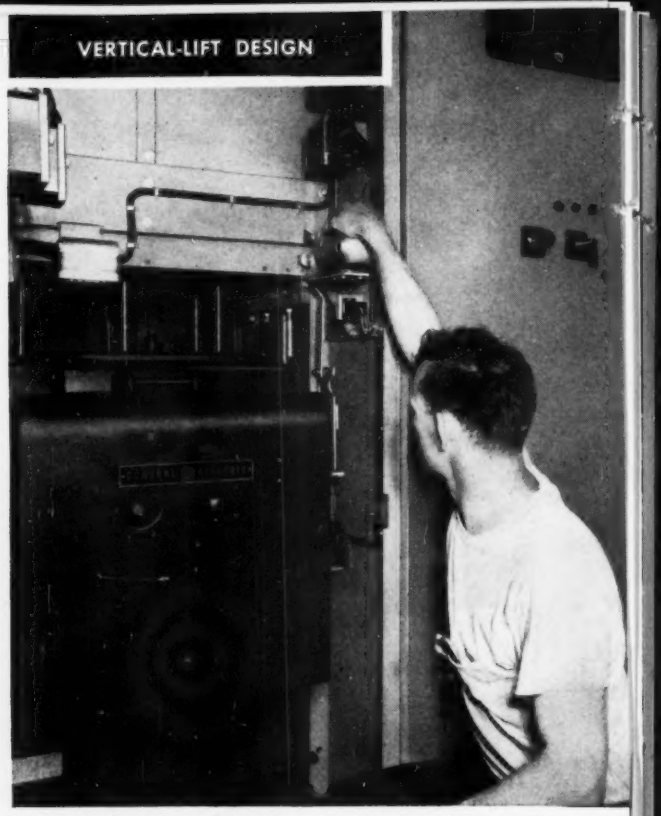
UNITED STATES RUBBER COMPANY

U.S.RUBBER
SERVING THROUGH SCIENCE

Electrical Wire and Cable Department

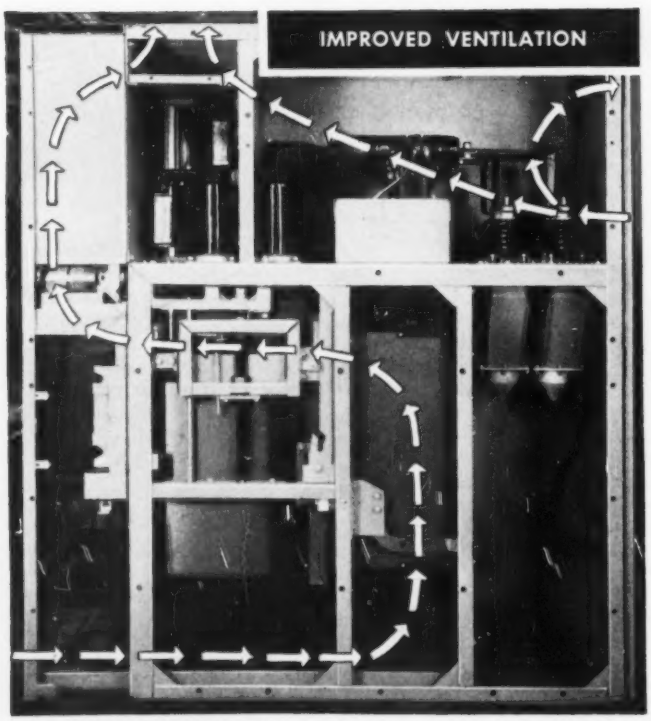
Rockefeller Center • New York 20, New York

GENERAL ELECTRIC'S" SELF-X" self-extinguishing insulation is used here (arrows) as flame-retardant insulating barriers for arc chutes of magne-blast breaker in improved G-E metal-clad switchgear.

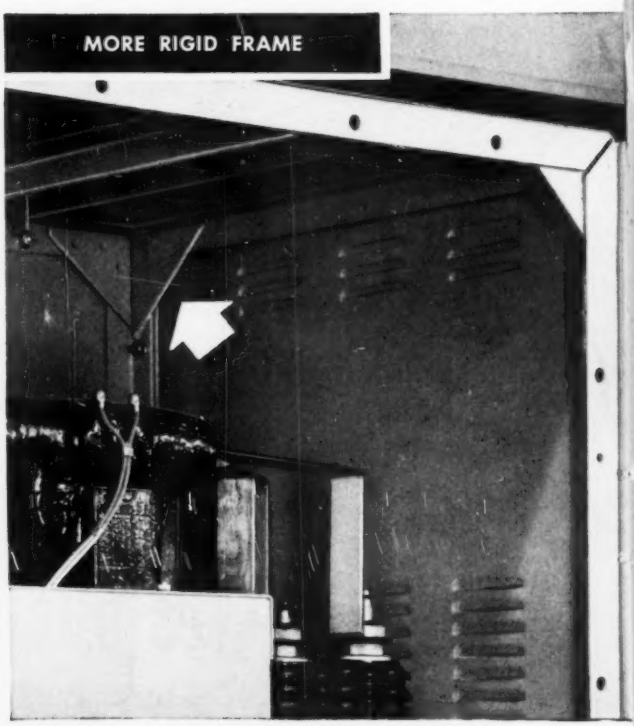


FASTER-ACTING MECHANISM, integral part of G-E vertical-lift design, raises, lowers breaker in 30 seconds. Vertical-lift isolates breaker—enables you to *SEE* disconnect.

Safer, stronger G-E metal-clad switchgear



NATURAL AIR DRAFT follows path of arrows, constantly ventilating entire unit. Vertical screened openings at top keep out foreign matter. Bus compartment is totally enclosed.



COMPLETELY WELDED FRAME gives rigid structure with gusseted corners (arrow). Sturdiness makes frame one solid unit to withstand jolts of cross-country shipment.

MAGNE-BLAST BREAKERS are easily, safely removed for inspection and maintenance from G-E improved metal-clad switchgear installed at Quaker Rubber Corp., Philadelphia. New, completely enclosed metal-clad 13.2-kv lineup, replacing old stationary circuit breakers, consists of incoming main line breaker, power company metering compartment, and four feeder circuit breakers.

assures reliable power at Quaker Rubber

New design features of 13.2-kv metal-clad give Philadelphia plant up-to-date protection for its expanded, modernized distribution system

When Quaker Rubber Corporation in Philadelphia installed a new power distribution system in its plant, engineers replaced stationary circuit breakers with General Electric's new, improved metal-clad switchgear.

Basic design of G-E metal-clad equipment remains essentially the same, fully meeting all industry standards. But the completely enclosed, pre-engineered units feature a number of G-E design advances—all reasons why Quaker Rubber selected G-E switchgear above other makes. For example . . .

G.E.'s new flame-retardant insulation, "SELF-X", with self-extinguishing properties that smother fire occuring under abnormal conditions, permits quick access for inspection and maintenance after localized damage.

Faster-acting breaker-elevating mechanism, part of G-E vertical-lift design, raises, lowers breaker in 30 seconds. Vertical-lift itself gives clear view of disconnected breaker.

Improved ventilation system for each complete switchgear unit cools all components with natural air drafts.

More rigid, all-welded frame provides sturdier construction—withstands shipment stresses better.

Advanced magne-blast breaker design gives easy access to operating mechanism and control relays—simplified contact design means longer breaker life.

For details on these design improvements in G-E metal-clad switchgear, call your nearest G-E sales representative. Or write for the booklet, GEA-5664-A, Sect. 874-5, General Electric Company, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Valve and Angle Valve.

BOILER BLOW-OFF VALVES

When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed. . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

Write for descriptive bulletin

EVERLASTING VALVE CO.
49 Fisk Street, Jersey City, 5, N. J.

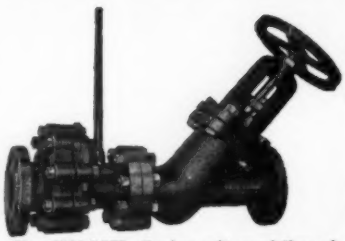


Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Valve and Y Valve.

Fig. 6571/6561. Duplex unit consisting of Y Valve and Angle Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Valve and Y Valve.

Everlasting Valves

Trade-Mark "EVERLASTING" REG. U. S. PAT. OFF.

for everlasting protection

More EQUIPMENT NEWS

Begins on page 158

rating up to 1500 lb. It can be ordered in either swivel or rigid types. Folder 599-53 available on request.

Bassick Co, Bridgeport, Conn.

Welding Positioners

1231 • Precision positioners for automatic or manual welding are available in 2500, 3000 and 6000-lb capacities. Variable speed drive, differential type with all components mounted on ball bearings, provide stepless speed change from 0 to predetermined top speed. Positioner table is driven by spur gear and pinion for minimum backlash and most accurate adjustment. Reducer is bolted to yoke to facilitate gear mesh adjustments. Table tilting speed is 135 degrees in 40 seconds, table height is adjustable in 6-in. steps.

Worthington Corp, Harrison, New Jersey

For more data on these items, use post cards p 167. Identify your request with item number.

Bearing Alloy

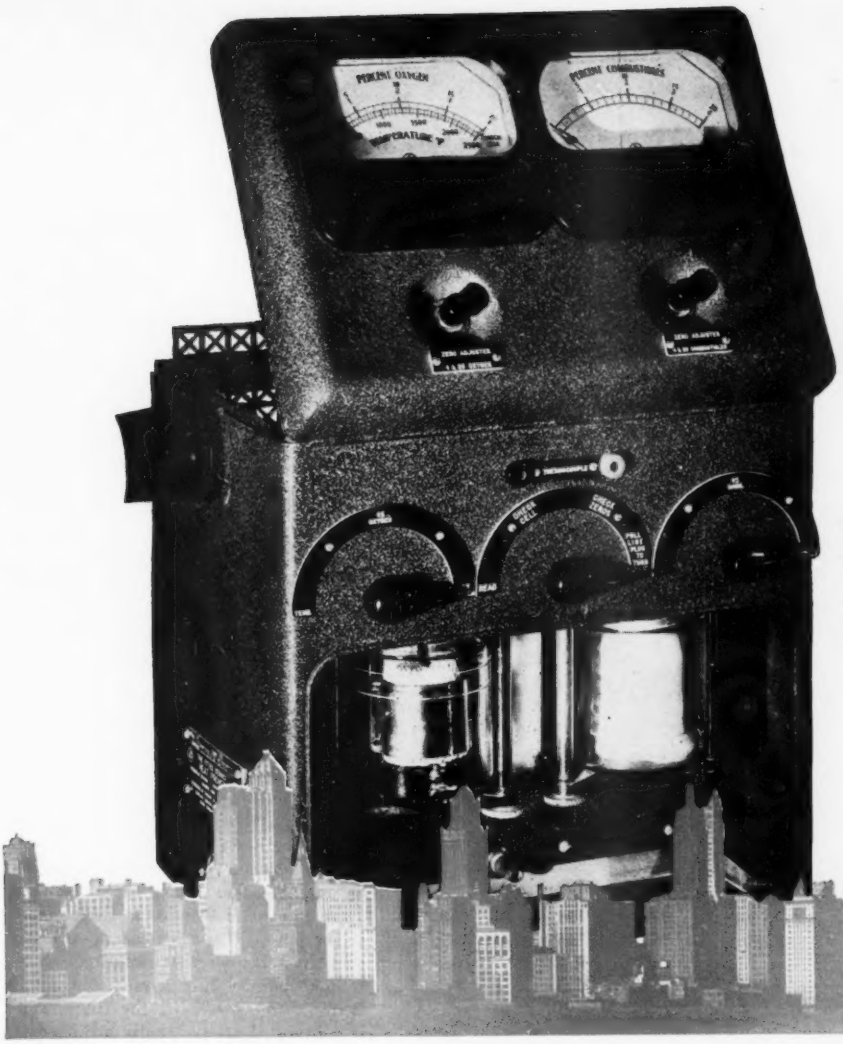
1256 • Designed especially as a bearing overlay, *Frix* is reportedly the first alloy to supplant wear properties of phos-bronze and bearing bronzes. Structure of deposit obtained with new rod after short heat treatment shows wear resistance several times greater than that of conventional bronze welding rods or electrodes. New material permits use of a film-like deposit that can be heated to secure maximum performance characteristics and that results in a completely integrated bearing.

Eutectic Welding Alloys Corp, 40-30 172d St, Flushing, N. Y.

Thread Restoring Tool

1263 • New patented thread restoring tool, *Nu-Trix*, reforms damaged external threads without reducing root and outside diameters. Used like a file, a few passes of tool across damaged threads removes burrs and deformed metal and restores thread to original condition. Device is available for either National Coarse or National Fine threads in eight sizes.

Reiff & Nestor Co, Lykens, Pa.



FROM THE TOP STEEL PRODUCER . . .
TO A LEADING CHEMICAL HOUSE,
A YEAST COMPANY
AND A MEAT PACKER . . .

Heat Prover SERVES 62 DIFFERENT COMPANIES IN THE GREAT CHICAGO INDUSTRIAL AREA!

The Cities Service Heat Prover is graphically proving its worth to all kinds of industry in the Chicago area and elsewhere throughout the country.

62 different companies, producing everything from steel to beef, have found the Heat Prover an important aid to increased production and big dollar economy.

WHEREVER A FURNACE OPERATION IS INVOLVED, Heat Prover can help increase productivity by providing:

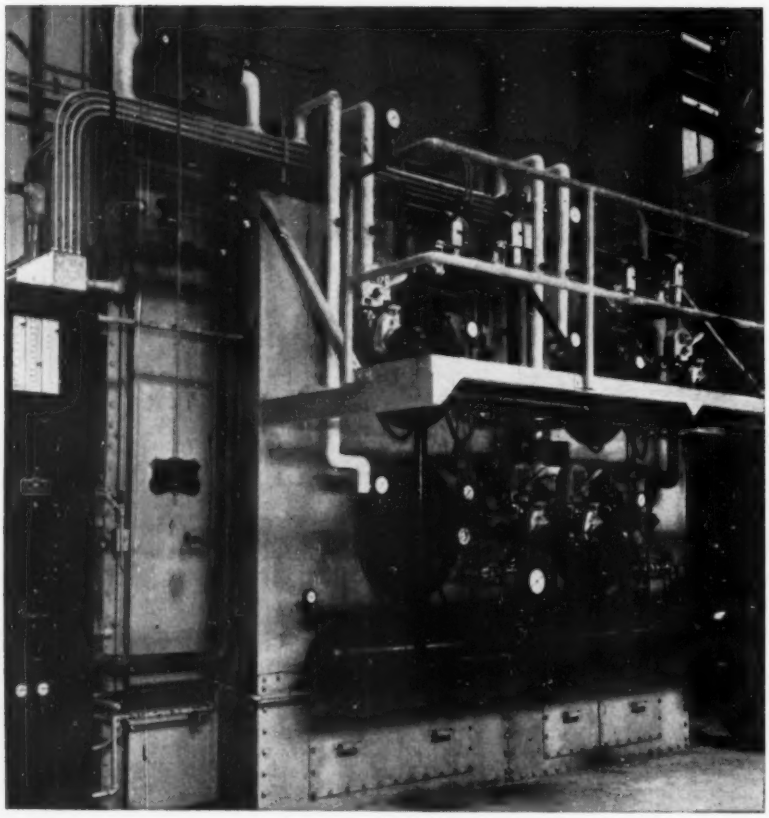
1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

REMEMBER: Heat Prover is not an instrument you buy but a service we supply. Contact the Cities Service office in your area and learn how Heat Prover can serve you . . . or write CITIES SERVICE OIL COMPANY, Dept. L16, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

ENCO
GAS-OIL
BURNERS
for
LOWER
Fuel Costs



The Enco gas-oil burners in this boiler will burn oil or gas—or both. The change-over is simple and is made according to the availability or cost of these fuels. Thus the plant can avoid a shut-down when one fuel cannot be obtained, or can switch from one fuel to the other according to the relative prices or the cost per btu. Combustion is uniform with either fuel or both, even though steam demands swing sharply—another fuel-saving, money-saving feature.
Other Enco burners offer similar economies for boilers of practically all sizes and types.

We invite inquiries on all burner problems — including those involving a wide range of capacities with a demand for complete atomization. We have had 35 years of experience in this field.

EC-101

THE ENGINEER COMPANY
75 WEST STREET, NEW YORK 6, N. Y.
IN CANADA: ROCK UTILITIES LTD., 80 JEAN TALON ST. W., MONTREAL, P. Q.

DIAPHRAGM PUMPS

Continued from page 125

Operation. When timer T energizes the solenoid valve O, it opens valve A and closes B, as shown. Air then flows through line L from the top of 3-way valve W, and through line L_1 to diaphragm D_1 to open valve F and close E. From here the air goes through valve F to line L_2 and the top of diaphragm D to force it down. Diaphragm pushes the solution out of the pump through discharge valve V_1. Air pressure remains on the diaphragm until a full stroke is made, as shown by the dotted lines.

When timer de-energizes the control valve, the solenoid core drops to close valve A, opens B. This shuts off air to D_1, releasing it through valve B and line L_2 into the 3-way valve, and out port P. Spring S closes F, opens E. This shuts off air from above diaphragm D, bleeding the space through valve F and port P. Diaphragm returns to position shown while pump fills for the next stroke.

Suction Head. Enough positive suction head must be on pump intake to move the diaphragm up, or vacuum must be used to fill the pump. From 3- to 10-ft net-positive-suction head is needed to fill the pump, depending on pipe size and arrangement, and viscosity of the fluid.

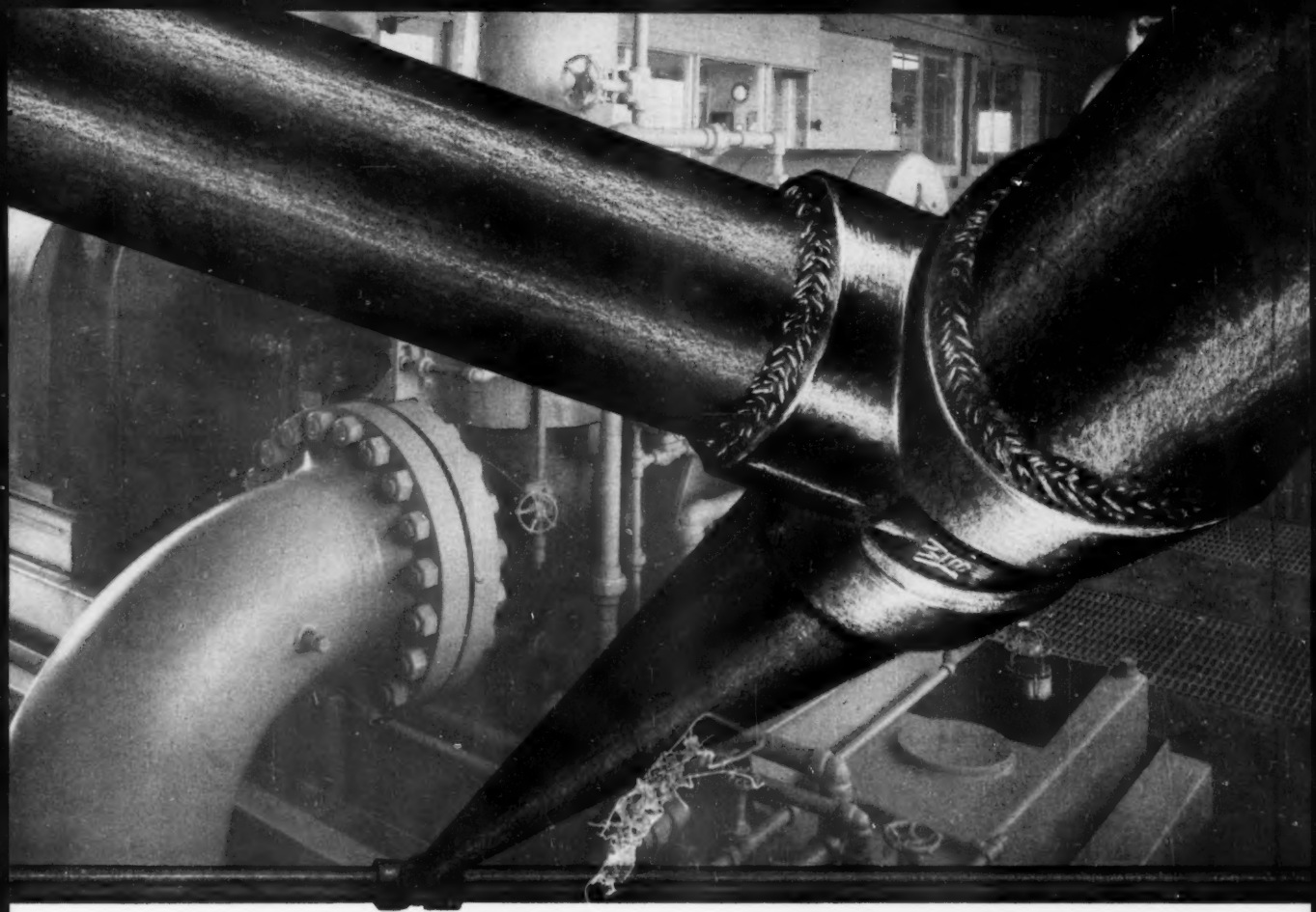
Setting timer for part capacity causes a delay between strokes before air pressure is released from the diaphragm and pump fills. The longer the time delay between strokes, the lower the capacity of the pump. Capacity can be adjusted over the full operating range.

Some pumps have a metering device to limit the stroke of the diaphragm. It consists of an externally adjusted inside-the-diaphragm cover. This gives accurate control of the volume handled, particularly with small quantities.

Pump in Fig. 2 is single-acting, has intermittent flow. If pulsations are objectionable, flow can be smoothed out with an air chamber on the discharge line. Reasonable steady flow can be obtained with two pumps actuated by a single timer with pulsations staggered.

Rubber Tube. A flexible rubber tube T, squeezed by a compressor ring R on an adjustable eccentric E, forms the pumping element of the unit in Fig. 3. In the position shown, the rotor is squeezing the tube to discharge liquid.

As the eccentric rotates counterclockwise, liquid is discharged by the compression ring as it moves to right. At the same time the compression ring releases the tube on left for suction. Link L prevents the compression ring from turning with the eccentric, so all rubbing action is between the ring and eccentric, and not on the tube. Single-stage pumps of this type require a check valve in discharge; 2-stage units don't.



Forged to Fit Power Problems . . .

WATSON-STILLMAN SOCKET-WELDING FITTINGS

Have you discovered the economy and low maintenance cost of an all-welded piping system? If so, you are already in line for still further advantages from this type of system when you start specifying Watson-Stillman Double-diamond FORGED STEEL SOCKET-WELDING FITTINGS.

Made on special machines from solid forgings whose material is selected for good weldability and in strict accordance with the required specifications.

W-S Fittings give you joints stronger than the pipe itself. Deep sockets, ease alignment, provide ample come and go for pipe sections, minimize field cutting and assembly problems.

Design of fitting is such that flow is smooth and uninterrupted by "icicles" or turbulence at the joint. Available in carbon, stainless and chrome-moly alloy steels.

For those applications where screw-end fittings are indicated, you can get the same superior physical and chemical qualities in the steel analyses you want by specifying W-S FORGED STEEL SCREW-END FITTINGS. Look for the double-diamond trademark. Write for literature.

SOLD THROUGH LEADING DISTRIBUTORS

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

133 ALDENE RD., ROSELLE, NEW JERSEY

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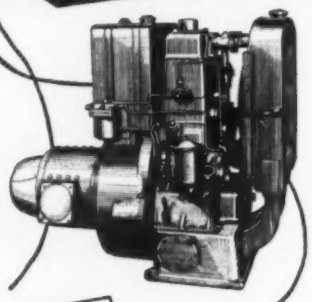
You get more for your money with NORDBERG DIESELS



COST LESS TO OPERATE

In addition to the low initial cost of the 1, 2 and 3-cylinder Nordberg "4FS" series Diesel engines, the outstanding design and construction of these compact units assures extremely low fuel and lube oil consumption . . . which has been proved in a wide range of power jobs.

MORE "EXTRAS"

Here are the "extras" that are all *included* in the low initial cost of Nordberg Diesel units: thermostatically controlled cooling system — heavy duty oil bath air cleaner — lube oil cooler — fuel and lube oil filters. *Compare* before you buy any 10 to 45 hp engine.

LONGER LIFE

Like all Nordberg Diesels, the "4FS" series engines are sturdily built to give years of reliable service with a minimum of maintenance time and expense.

Clip the coupon for details on Nordberg Diesel power units from 10 to 45 hp—Diesel generator units from 6 to 30 kw—or for Diesel pumping units in capacities from 200 to 3000 gpm at 15 to 240 ft. total head.

NORDBERG MFG. CO., Milwaukee, Wis.

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MAIL THIS COUPON TODAY

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Send catalog covering Nordberg Type 4FS Diesels. I am interested in a unit for the following service: PM

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Your Name.....

Company Name .....

Address .....

City..... Zone.... State....

4-553

WATER TREATMENT

Continued from page 101

with calcium or magnesium. To forestall this development, you need still higher alkalinities. Moreover, the greater the feedwater silica content, the stronger must be the boiler water's caustic alkalinity, to safely retain silica in the form of soluble sodium silicate.

Alkalinity Restraint. It follows that the more elevated boiler-water alkalinities become, the more effective treatment is. However, there is a limit to the degree of alkalinity each specific boiler design can sustain and yet furnish good-purity steam. Sudden surges in boiler-water causticity can cause violent priming. And persistently high alkalinity concentrations will induce continual carryover of boiler-water solids with the steam. Steam-purifying units are inefficient under such burdensome demands. In a watertube packaged unit alkalinities, yielding a maximum pH value of 11.5, can be carried with a moderate measure of safety. Consequently, boiler-water alkalinities within the pH range of 10.5 to 11.5 assure (1) driving down the calcium hardness entirely as the desired phosphate (2) removing magnesium hardness completely in the hydroxide form, while (3) still keeping silica soluble.

Embrittlement Prevention. Certain tannin derivatives offer protection against intercrystalline cracking of boiler metal besides functioning as an effective coagulant for hardness precipitates. Furthermore, the surplus of phosphate carried to ensure zero hardness also serves as an added inhibitor. so normally you need not add more chemicals.

Blowdown. You can't precipitate any amount of hardness nor hold any quantity of silica in solution within any boiler. There are definite limits whether or not internal water treatment does a satisfactory job alone, and much of the success relies heavily on the demand a selected water treatment places on blowdown. Rate of blowdown, in turn, is governed primarily by the maximum total solids content permissible at your particular operating pressure. Feedwater chemical characteristics and the boiler pressure may combine to cause foaming and carryover or undesirable deposits that you cannot prevent without excessive blowdown. In this event, external presoftening and silica reduction become a necessity.

For watertube packaged boilers, schedule a minimum of two sludge blows per unit per day. Make it a daily practice, even if such blows are to be mere puffs. Give one blow in early morning and the other in late afternoon during comparatively light loads

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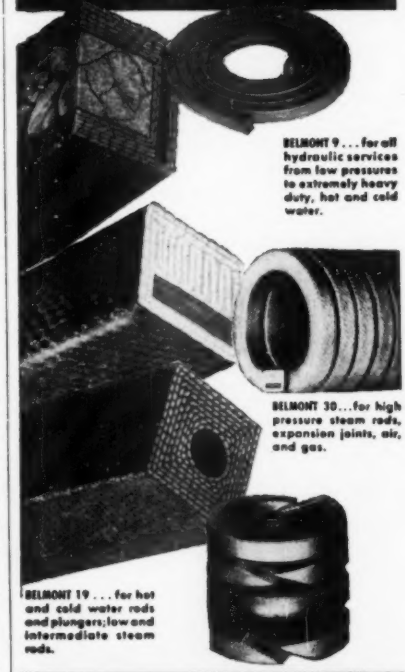

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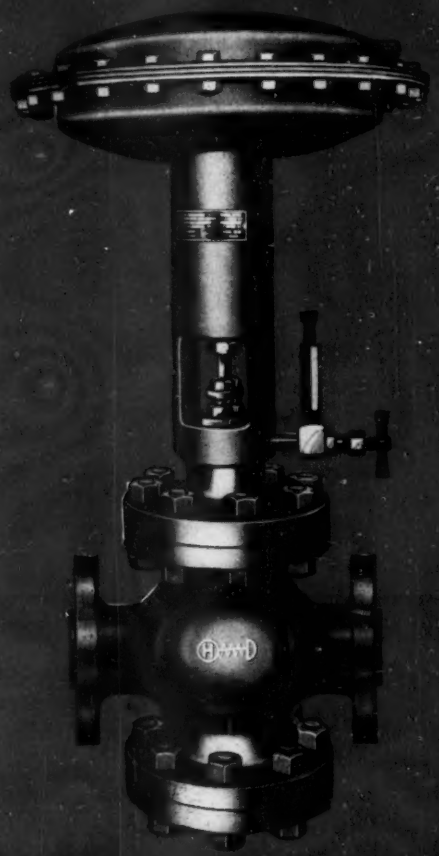

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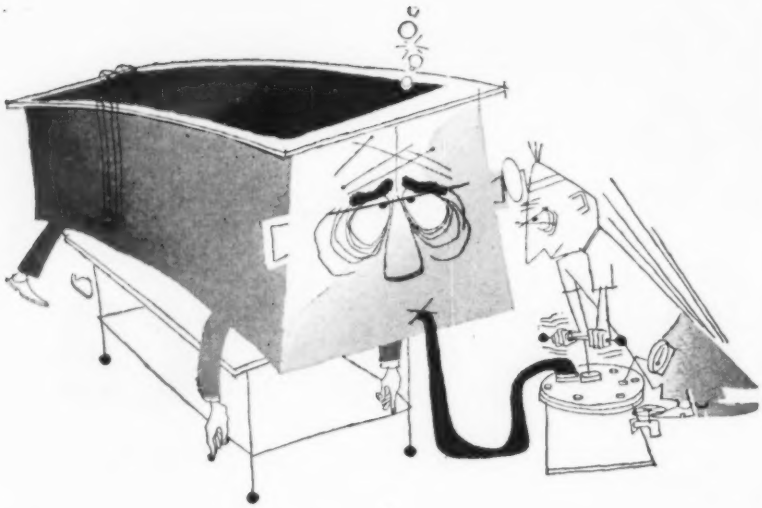

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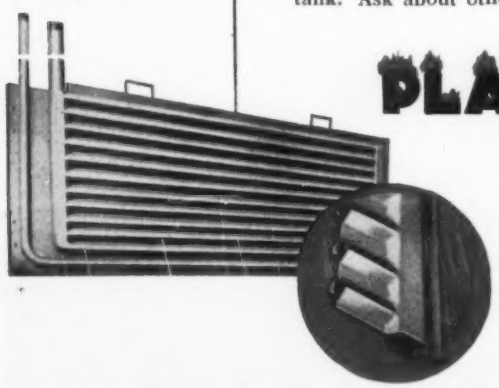

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*Coil-itis — Diagnosed as tank heating and cooling problems. Platecoils — the prescription for solving pipe coil problems.

PLATECOIL DIVISION, TRANTER MANUFACTURING, Inc., Lansing 4, Michigan

WATER TREATMENT

Continued from page 216

so you take advantage of the settling out of boiler-water precipitates. Under heavy loads you'll undoubtedly need additional blows. Space these blows equally between the standard two. When you have to decrease the boiler water's dissolved solids content, make your bottom blows fairly long. But if you want only to rid the boiler of an over-accumulation of sediment, frequent short blows become more effective.

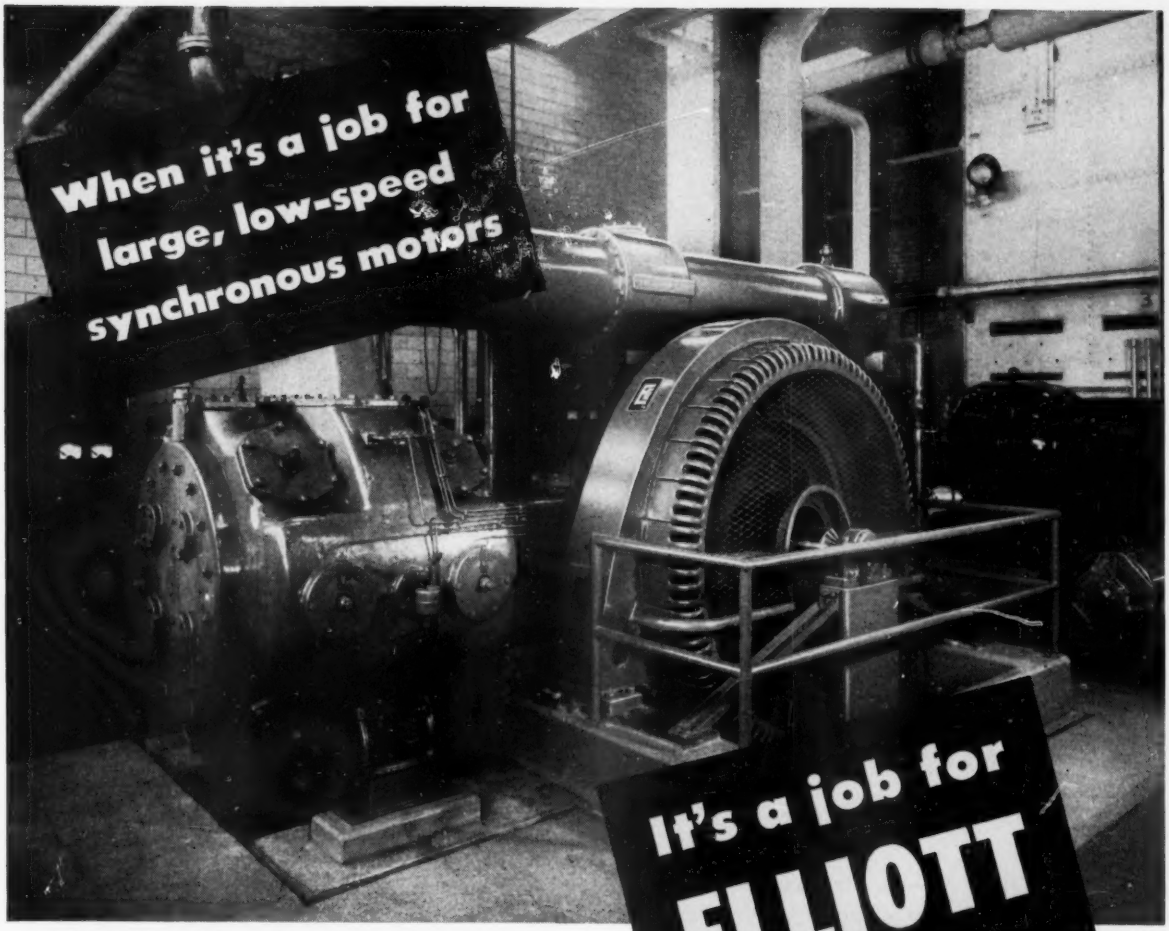
We feel it is always most desirable, and certainly so in extreme cases, to put in continuous blowdowns on these packaged boilers. This blowdown system makes for more uniform operation and permits less reliance on the bottom blows, although you still have to carry on the primary daily two. Remember, though, that the continuous blowdown takeoff is in the steam drum, where the feedwater and chemical treatments also make their entry. And you'll have to be doubly sure there is no short circuiting. In the single-drum design install this takeoff in the rear quarter of the drum, where boilerwater concentrations are at their highest. For the 2-drum unit with baffle plates either over or in front of the upriser tubes, extend the takeoff along this channel. Where there is no baffling, spot the takeoff in the hottest quarter of the steam drum, just off the upriser outlets.

Chemical Feed. Internal treatment must be injected into the boiler each day. Moderately low pressures and fairly stable conditions may permit the shot-feeding of chemical correctives once or several times daily, through a bypass arrangement on the discharge line of the feedwater pump.

But demand for more uniform chemical balances at the higher operating pressures makes the separate and continuous feed of treatment compulsory. For the single-drum design, have the chemical entry in the front quarter of the drum. In the 2-drum unit, discharge chemical at the cooler end of the steam drum, just ahead of the down-comer tube ends. Never feed chemical treatment directly into the mud drum of the 2-drum boiler. If you do, you run the risk of dangerously fouling the much hotter upriser tubes from belated hardness precipitation.

Control Tests. Water treatment itself, at best, can fulfill only half the job of keeping your boiler clean. The other half consists of your day-by-day control over feed of chemical treatment and blowdown, plus the caliber of supervisory services you get, especially in times of trouble.

You never fully catch up after lags or omissions in feed or blowdown, and invariably a dirty boiler follows. Scale,



Elliott 600-hp, 300-rpm, low-speed synchronous motor driving an Ingersoll-Rand compressor.

Outstanding construction features:

- Mica wrapper or tape on slot portion of stator coils for long life.
- Large area starting winding joints resistance brazed with silver alloy for strength and high electrical and thermal conductivity.
- Fine workmanship throughout.

• Like all large Elliott motors, these motors are designed to fit the installation. Starting, accelerating, pull-in and pull-out torques, power factor correction and other important factors are all tailored to the requirements. And whether open or totally-enclosed, Elliott low-speed synchronous motors may be given a number of mechanical protection, cooling and mounting arrangements. Back of this design flexibility are the built-in ruggedness and efficient operational characteristics which combine to make these motors the perfect teammate for compressors, pumps, Jordans, rolling mills, ball mills, etc. For complete details and ready reference, write to Elliott Company, Ridgway, Pa., for the low-speed Synchronous Motor Bulletin.

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F. D. Fans Double inlet with radial inlet vanes; outlet dampers; rain hoods and recirculating duct connections. Capacity for each fan: 110,500 cfm; 100 F; 14.7" SP; 1180 rpm; 348 hp.

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Green Fans can show an excellent record of efficiency and durability. They can be found in many of the leading and recently completed utility and industrial power plants. They have back of them a fund of knowledge about fan requirements and fan design. They serve their users well.

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WATER TREATMENT

Continued from page 218

while quick to develop, is quite slow to deteriorate. Under boiler operating conditions scale is only sparingly, if at all, redissolved. The result, should you succeed in catching up, is an abundance of small bits of scale, not easily removed by blowdown. Instead, you'll find they tend to accumulate in points of slow circulation, where they may later build up to harmful proportions.

Normally, for operating pressures up to 100 psi with fairly stable conditions, you can establish a standard blowdown practice and regulate feed of chemical treatment daily by making a simple phosphate colorimetric test of boiler water. With pressures from 100 to 250 psi you have to go further and control blowdown by running daily tests for the boiler water's alkalinity and chloride concentrations. For pressures between 250 and 400 psi, various additional tests become necessary depending on the external-treatment method you use as well as other specific problems that demand greater attention and control.

Boiler Openings. When employing a new type of treatment, you'll find it wise to take your boiler down for at least two checkups during the first six months. Then with satisfactory internal conditions established, open it semi-annually. The midyear opening serves merely for washing out the unit to maintain peak efficiency through the next six months and facilitate the thorough cleaning to follow. Where scale is causing deterioration, you'll need frequent clean-outs. Refrain from turbining the tubes of your boiler, unless you have no other choice. Turbining scores tube bends and greatly shortens tube life. Instead, pass a wire-brush rotary attachment through the tubes once yearly.

BEARING FAILURES

Continued from page 121

friction of the lube. And there's some sliding friction too—especially between balls and retainers in deep-groove bearings and where the rollers have become skewed.

Studies show that rolling friction hinges on size of balls or rollers. The smaller these elements are, the higher the friction. Oddly enough, friction, traced to churning up or pushing aside the lubricant, and pure hydrodynamic pressure may be much greater than normal rolling friction of the bearing elements. Then why lubricate? For one thing, lubrication helps cut sliding friction. It also prevents seizure, carries

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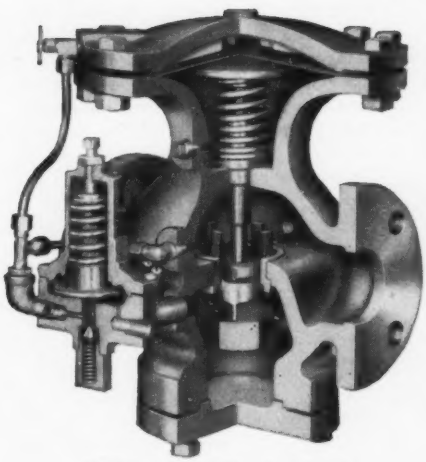
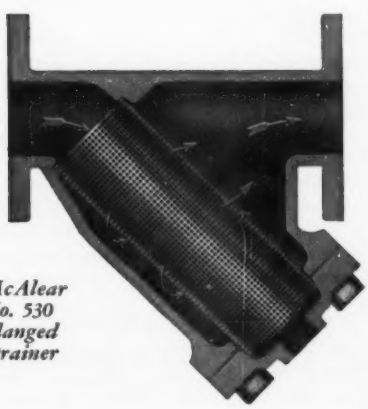


McAlear 228 Pilot-Operated Pressure Reducing Valve

Behind each unit of McAlear control equipment is a half-century of specialized engineering experience reflected in an enviable reputation of dependable service!

The No. 228 Pilot-Operated Pressure Reducing Valve (left) is accurately sensitive and dependable where positive and automatic control of reduced pressure is required in steam service.



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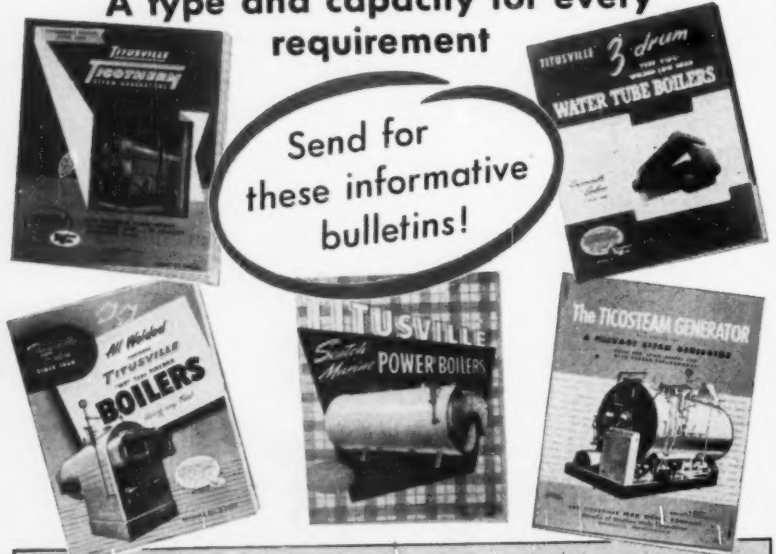
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BEARING FAILURES

Continued from page 220

away heat, helps sealing and protects against corrosion.

How Much Lubricant? How lubrication affects friction of a rolling-contact bearing depends on what kind of bearing we have in mind. Remember that commercial bearings are available costing only one-fourth to one-sixth as much as the well-known precision type. These may be used for lighter loads and slower speeds. Lower cost comes from greater tolerances, lack of retainers or ball spacers, etc.

The research boys have found that a precision bearing will show slightly greater friction when lubricated than when dry. But just the opposite may be true for the low-cost type, where lube helps cut the greater sliding friction at the start. Generally, though, precision bearings are the type used in electric motors. In either case, friction is lowest when but a thin film of oil covers contacting surfaces.

MARMADUKE

Continued from page 146

"Old chief Drummerhauser barged in about then with his assistant in tow. Jake was as gay as a lark and felt all hopped up about the way I had prepared for this job. When I told him our trouble, he turned purple around the gills and let out a blast heard across the bay in Alameda.

" 'What stupid jackass caused this mess?' he roared, the words almost choking him.

"After blowing a few gaskets he threatened, 'I'll see the dirty bum gets a year in Alcatraz for planning to wreck a public utility.'

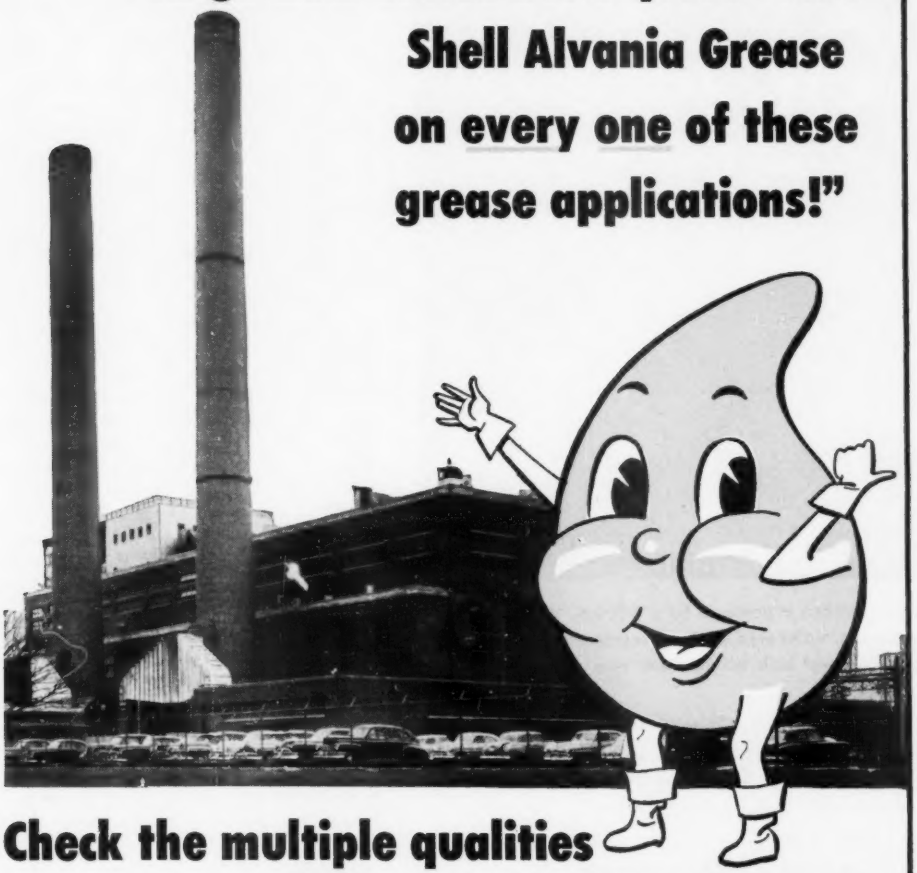
"By then his smart young assistant was checking the condenser tube order in the office. And what do you think he found? Why, he discovered that the chief himself made that mistake, that's who. Evidently Jake had gotten the tube information from the wrong condenser blueprint.

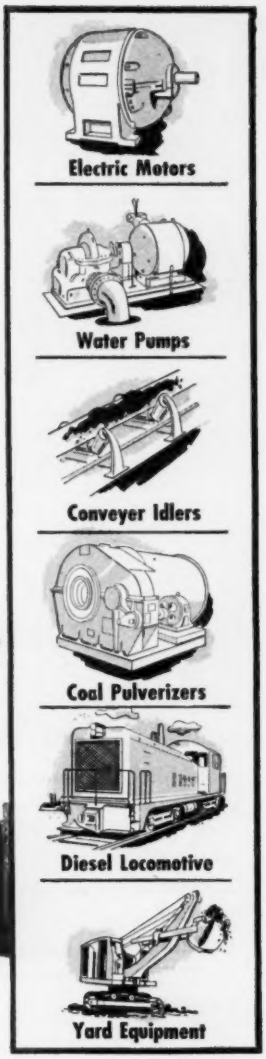
" 'Here it is in black and white,' said the assistant, showing the boss the order. Right then old Drummerhauser blew his one remaining gasket. He sank slowly down on a condenser tube packing box and wiped the beads of perspiration from his forehead. All the steam was out of him by then. He just sat there, wilted, like a dry boiler tube in a live furnace.

" 'On your toes, gang,' I ordered. 'Back to the machine shop. I've been in worse hurricanes than this without

(Continued on page 224)

"Indianapolis Power & Light Company's large new White River plant uses Shell Alvania Grease on every one of these grease applications!"





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Shell Alvania Grease is effecting important improvements in plant maintenance and purchasing practice. In plant after plant, this one grease is replacing the many special purpose greases formerly used . . . for *every grease application in the plant!*

Look at these advantages:

1. Shell Alvania Grease flows *freely* in cold temperatures, yet will not run out of bearings under excessive heat.

2. Ideal for wet, humid applications . . . it resists water emulsification.

3. Shell Alvania Grease has extremely high oxidation stability.

4. You'll find that Shell Alvania Grease extends time between greasings . . . a substantial saving in labor and grease.

5. Simple inventory . . . just the one grease to stock and apply.

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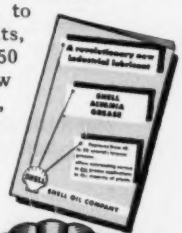
The economy of handling just one grease instead of *many* is an established fact. Write for the new booklet on Shell Alvania Grease . . . to Industrial Lubricants, Shell Oil Company, 50 West 50th Street, New York 20, N. Y.—or, 100 Bush Street, San Francisco 6, Calif.



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How much does 2°F cost YOU?

QUESTION — A manufacturing process is powered by a 8000 K. W. turbine. For the most economical operation, water used in the process should be cooled from 105° F to 85° F, at 77° F wet bulb temperature. How much will this cooling tower cost?

ANSWER — A tower with a .78 water-air ratio is needed and will cost about $50,000.

QUESTION — How much can be saved if the tower cools from 107° F to 87° F at 77° F wet bulb temperature — 2° F higher temperature?

ANSWER — This tower will require a .95 water-air ratio, and will cost only .78/.95 x $50,000, or $41,000, a saving of $9000 in initial cost.

QUESTION — Then, isn't the second tower the better buy?

ANSWER — Before answering, let's examine your operating cost. The steam needed to operate a 8000 K. W. turbine costs about $750 per day. The 2° F overage on the second tower will increase your fuel consumption 3%, so your operating cost will be increased $22.50 per day, or $6750 per 300 day year. In ten years, your operating cost will be increased $67,500, or more than the initial cost of the first tower. The answer is definitely, No!

When considering a new cooling tower, get the best engineering advice possible — consult a WCEC engineer. And after your tower is built, installed, and in operation, be sure that it meets your specifications.

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MARMADUKE

Continued from page 222

going down. You can't save a sinking ship by stopping the engines.'

"My mechanics crowded around me in the shop. It was plain they were wondering how I'd lick this problem. I started sketching a rig for finishing the job. I doped out a 20-ft steel table made of heavy channel iron with four legs about three feet high. On one end, I showed a cylinder and piston to be worked by feedwater.

" 'What in hell is this, a drawing class?' barked Drummerhauser. He'd finally come out of his trance and wobbled into the shop.

" 'This contraption is going to stretch those tubes exactly three inches,' I replied. Drummerhauser blinked a few times and went out of the shop, muttering to himself. He was a top-notch engineer, but a bit short on imagination. Sounded like he was saying, '. . . what does he think those bronze tubes are made of, rubber or something?'

"After six hours our stretcher was finished. The long channel-iron stand had an old simplex feed-pump cylinder assembly at one end to do the pulling. We placed a 3-inch snug-fitting steel plug into each end of a new condenser tube. Then we fastened two steel clamps over the outside of each tube-end so they squeezed against the plugs on the inside. The clamps were bored to the exact outside diameter of the tube and split on one side so tightening two nuts sandwiched the tube-ends between the clamps and the plugs. That prevented changing these dimensions during stretching.

"We hooked one clamp over a bolt at one end of the steel frame. The second clamp was hooked through a hole in the end of the piston rod. By cracking a valve from the feedwater system, the piston started stretching the tube until it traveled exactly three inches.

"We soon got down the routine of removing the steel-plugs from a stretched tube, then tapping them into a new tube. Two men would place a tube onto the long channel-stand, bolt the clamps at two ends, hook them in place on the end of the stand and the piston rod. Then one man would crack the liquid valve until the piston stopped, which was after exactly a 3-inch travel. Then he'd open the cylinder drain, remove the stretched tube and start on another tube. My boys got this job down so well that in no time those old tubes were flying out of the condenser."

At this point O'Houlihan cut in skeptically, "That's a good story, Marmy, and I've stretched a few tubes myself —in a pinch. But tell us how long those tubes lasted.

Exclusive features of design plus quality controlled materials and workmanship are the reasons

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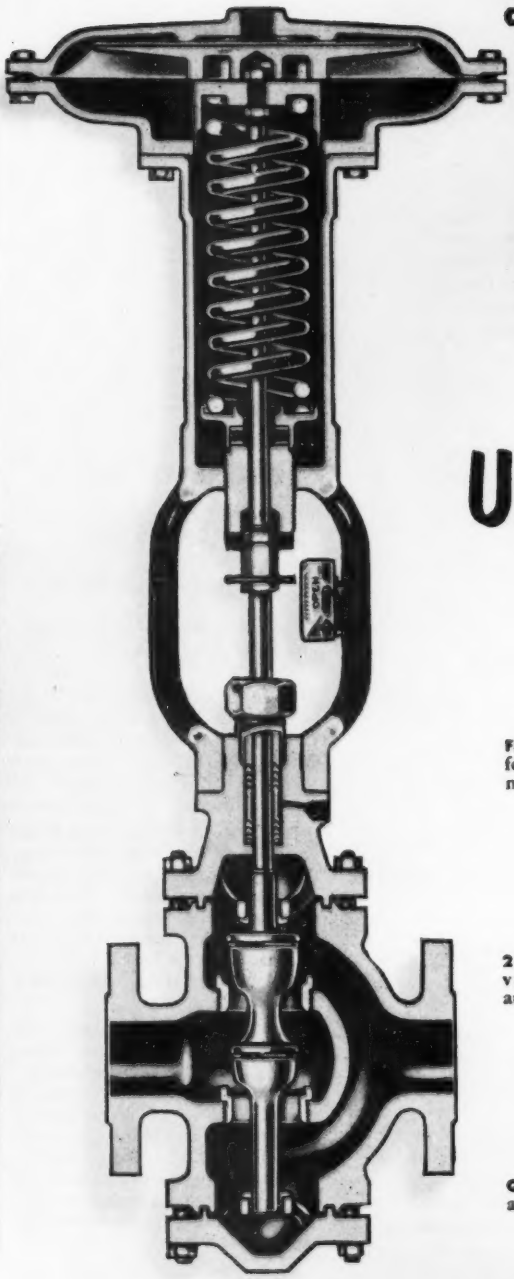
Diaphragm Motor Valves are Universally Preferred



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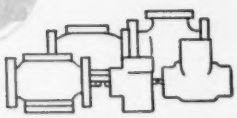

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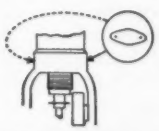

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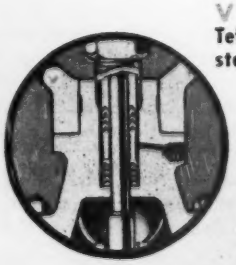

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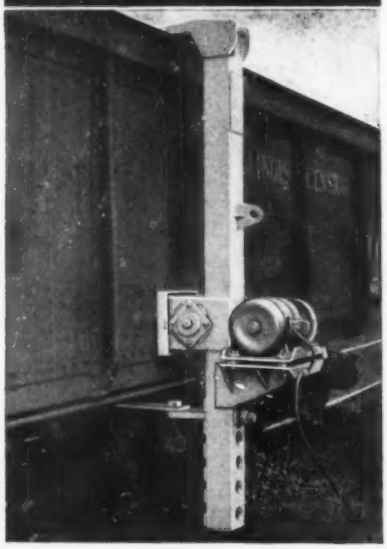

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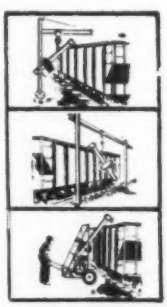

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MARMADUKE

Continued from page 224

"Lasted!" bellowed Marmy, lighting up his cigar stub. "I dropped into that plant 15 years after doing that job. And everyone of those tubes was still in that condenser."

With that, Marmaduke Surfaceblow Esq., consulting engineer extraordinary, majestically shoved off for his upstairs office. But he let go another broadside before disappearing through the door.

"On a 20 foot bronze tube, a three inch cold stretch isn't enough to be noticed," he barked.

"If Marmy says all those tubes held up, then I guess they held up, because he seems to know everything and seems to have done everything," O'Houlihan put in skeptically before the audience broke up. "But just the same," he continued, "I wouldn't recommend stretching tubes like that unless it was strictly a sink or swim proposition." *SME*

More TECHNICAL BRIEFS

Begins on page 154

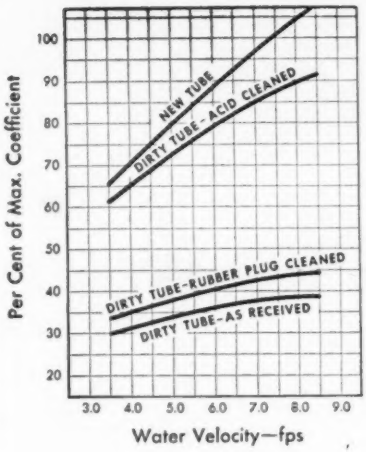
tph belt conveyors. Each of these belts is provided with a weighing device to control weight of coal on conveyor. These two belts elevate the coal to a transfer point at the station where the coal is discharged to two similar belts which in turn discharge the coal directly to the first bunker without the benefit of a tripper, shuttle conveyor or similar device. This portion of the coal handling facilities is intended to operate on a continuous basis.

It is the aim of this design to provide a large outdoor active storage capacity that can be drawn upon continuously and automatically at a rate to be determined remotely by the operators in the control room. The delivery of coal to the individual bunkers will be such that it will correspond to the actual burning rate except for the last bunker in operation at which point some fluctuation will occur requiring the observation of the operator and adjustment of the coal flow rate. *ASME Paper No. 53-F-28*

Directions for ordering papers on p 156

Installation of Fuel Gas Piping on Premises of Industrial Consumers. *By Edmund L Spanagel, Rochester Gas and Electric Corp.*

Fuel gas piping on premises of industrial consumers is partially covered in the Code for Pressure Piping, of the American Standards Assn, ASA B31.1. However, the material covered in that



Best way to RESTORE condenser tube EFFICIENCY

90% of surface condensers do not perform as well as they should. One major cause is fouled tubes. And, only too often, when such tubes are rubber-plug cleaned, the results prove far from satisfactory.

In a recently reported test, it was shown that shooting rubber plugs through a fouled tube didn't fill the bill in successfully removing the type of scale encountered. See chart. But when the same tube was acid-cleaned, the heat transfer obtained approximated that of a new and clean tube.

Removing lime scale with that effective acid-descalant, Oakite Compound No. 32, more than repays for itself by the savings it makes in reduced turbine-steam consumption and lower fuel costs. It minimizes tube failure caused by partially obstructed tubes and eliminates the cost both of replacing tubes and of idle condenser capacity.

After you have removed lime scale with Oakite Compound No. 32, you can prevent further build-up by treating condenser circulating water with Oakite Airefiner No. 52. For further details, write for booklet. No obligation. Oakite Products, Inc., 23 Rector Street, New York 6, New York.

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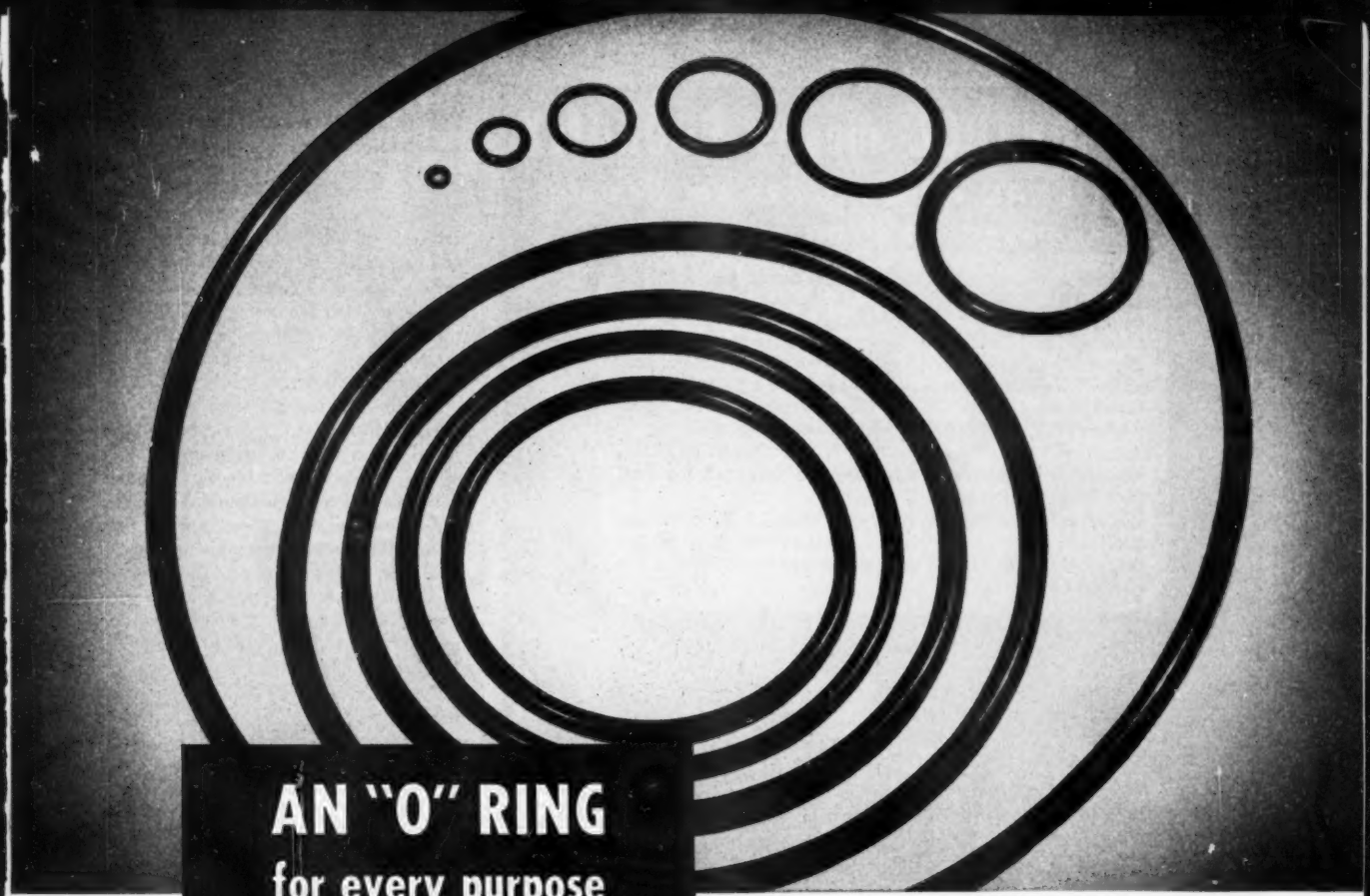

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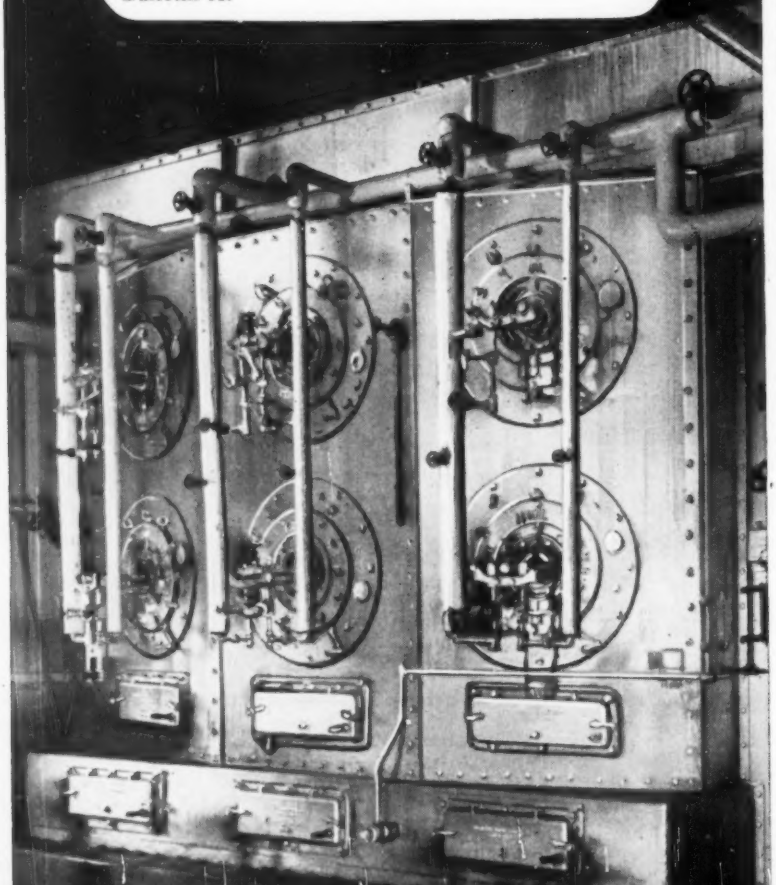

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More TECHNICAL BRIEFS

Begins on page 154

code is not sufficiently detailed for practical application. This paper reports on progress toward the preparation of a comprehensive standard for such work. It is intended to cover proper methods and procedure for the layout, installation and testing of piping systems for distributing fuel gas within the premises of an industrial plant.

Eventually this may be used as the basis for American Standards to cover installations of consumer-owned gas piping and equipment on the premises of industrial and commercial consumers—those not now covered by A.S.A. Z21.30-1950, which pertains to the installation of gas piping and appliances in building, but which covers only residential and commercial consumers and applies only to gas at low pressure (not in excess of ½ psi).

The Public Utility Industry has been promoting the application of manufactured and natural gases to industrial heating processes ever since the early years of World War I. The use of gaseous fuels for such purposes has expanded at an ever increasing rate, so that in 1952 gas sales to industries in the United States amonted to 28½ billions of therms (100,000 Btu), representing over one-half of all gas utility sales and approximately one-fourth of the gas utilities total revenues.

Despite the great increases in the use of gas in industry throughout these many years, there remained a great need for practical rules or regulations—"code" if your please—to govern the installation of gas piping or gas utilizing equipment to promote safety and user satisfaction in industrial plants. It was accordingly decided only about a year and a half ago, in April 1952, that one of the newer committees in the Industrial and Commercial Section of the American Gas Association—namely, the Industrial Gas Practices Committee—should assume the task of preparing a detailed outline covering standard requirements for industrial consumers' gas piping systems. Furthermore, it is the hope of the Section that this Committee's work in this regard might eventually serve as a basis for a new American Standard covering gas piping in industrial plants in particlar as well as all consumer-owned gas piping carrying pressures in excess of one-half pound per square inch gauge.

Since the preparation of a set of ASA standards is a rather involved and lengthy procedure, the Industrial Gas Practices Committee prepared and published an interim coverage of this subject in the form of Information Letter No. 48, sent to members of the Ameri-

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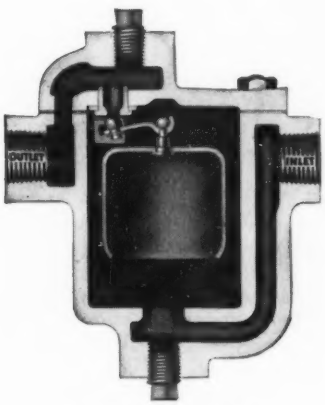

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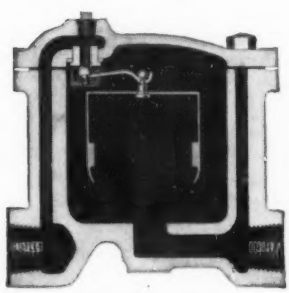

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Duo-Step is the revolutionary double fulcrum principle that affords maximum leverage to "crack" the valve from the orifice seat, teamed with "Follow-through" power that opens the orifice completely. This double action actually gives you double the drainage capacity of ordinary steam traps.

MODEL 60-D traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400° F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½″ or ¾″ horizontal inlet and outlet connections with ¼″ test outlet and drain plug. Vertical inlet can be furnished in ½″ or ¾″ size.

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MODEL 70-TD for pressures to 150 P. S. I. and temperatures to 375° F. is available WITH BUILT-IN THERMAL BY-PASS at additional cost.

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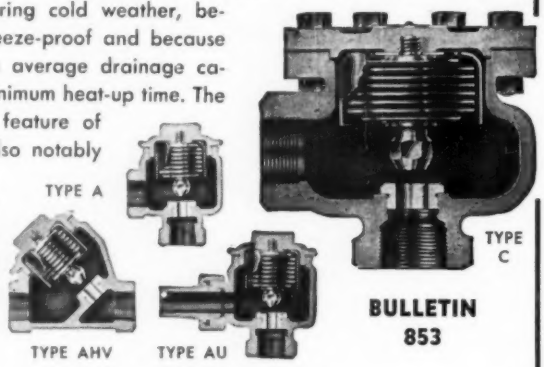

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More TECHNICAL BRIEFS

Begins on page 154

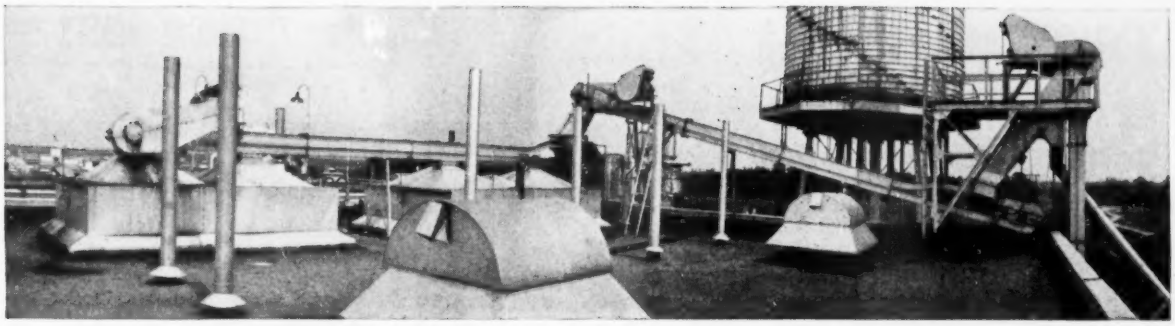
can Gas Association. This information letter, which covers only the basic principles of industrial gas piping, is entitled, "Suggestions Pertaining to Above-Ground Gas Piping Within Industrial and Commercial Premises." Copies can be obtained without charge from the American Gas Association Headquarters at 420 Lexington Avenue, New York 17, N. Y.

Meanwhile the Industrial Gas Practices Committee has continued working toward the preparation of a comprehensive document which will give detailed recommendations and approved practices with regard to the installation of consumer-owned fuel gas piping and gas utilization equipment on industrial and commercial premises.

These basic standards are planned to govern specifically the installation of consumer-owned gas piping, both in buildings and between buildings extending from the utility company gas meter outlet to the inlet connections of appliances; and the installation of consumer-owned gas utilizing equipment. It is proposed to cover piping systems for industrial installations at any pressure and for all other non-residential installations at operating pressures in excess of ½ psi gage, installation and testing of these systems for fuel gases such as natural gas, manufactured gas, liquefied petroleum gas-air mixtures or mixtures of any of these types, but not cover systems for undiluted liquefied petroleum gas or those handling gas-air mixtures within the limits of inflammability. Protective atmosphere gases are not covered.

Part I outlines the proper procedure in case of any emergency and or necessity for doing work on the gas service pipe, the gas company's meter, etc—that is, on any part of the service installation containing unmeasured gas. This part also gives general precautionary advice with reference to shutting off gas piping systems to make new connections, repair leaks, etc. With reference to gas leaks, it seems almost needless to mention here that checks for gas leakage should be made by brushing a soap and water solution on the suspected areas, that artificial illumination used in such searches should be restricted to flashlights or fixed electric lights controlled by switches remote from the area of leakage and that smoking, open flames, lanterns, or other sources of ignition should not be permitted when working on piping which contains, or has contained, gas.

Part II covers the fundamentals to be observed in the planning, design, sizing of pipe and selection of valves



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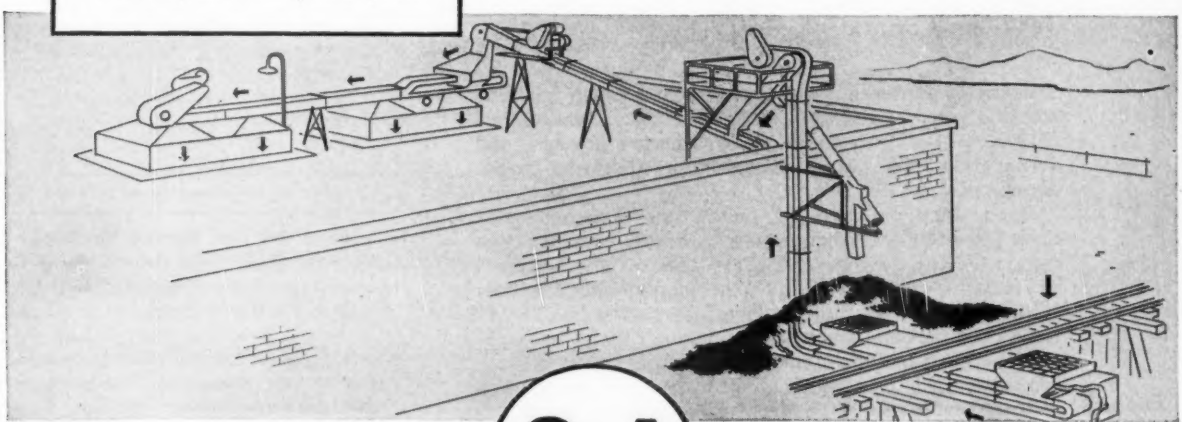
This S-A REDLER Conveying System utilizes "dead" rooftop space for a high capacity, multiple-discharge feed line for stoker hoppers. Construction costs were minimum, because the enclosed REDLER needs no shelter from the weather. Hopper capacity is greater, since there are no conveyors inside the building to take up headroom. And, of course, spotless-clean, dust-free REDLER handling is a big advantage for this finishing plant.

Here, as usual, S-A engineering goes beyond mere provision of "adequate" conveying. It capitalizes on a complete line of efficient bulk handling equipment—a line so complete that there is a conveyor or combination to meet every problem of plant layout, *including yours*. Write for a free survey.



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More TECHNICAL BRIEFS

Begins on page 154

installation, testing and purging of the entire fuel gas piping system.

In the first place it is recommended that gas piping should always be located safely; in other words, gas piping should not be placed under floors, in unventilated crawl spaces or concealed in solid masonry partitions. Where such locations cannot be avoided, it is recommended that the gas pipe be encased in a larger pipe with a removable seal provided for leak inspection at the inner end of the casing. Furthermore, gas piping should never be laid in cinder fill and cognizance should always be given to the desirability of protecting buried steel pipe against corrosion by suitable protective coating or by cathodic means. Many gases, and manufactured gases in particular, contain moisture and piping carrying these gases should not be exposed to freezing temperatures, whether above or below ground.

Considerable attention is to be given to the problem of sizing the piping system, for it can be stated that probably there is no other single factor that has given more difficulty and dissatisfaction in the operation of gas utilization equipment than that caused by inadequate or fluctuating gas pressures which, in turn, have been caused by inadequate pipe sizing. The rather wide prevalence of undersized gas piping results from a number of factors, but undoubtedly the principal factor has been the failure on the part of the plumbers and piping contractors to appreciate the fact that gas is commonly delivered at a relatively low pressure (2 or 3 oz per sq in.) and hence an excessive loss in pressure is readily created by friction in too small piping or by too many bends. The resistance of valves also has been frequently disregarded. *ASME Paper No. 53-F-17.*

Directions for ordering papers on p 156

Lighting Off and Starting Up Precautions for Stoker Fired Boilers. *By Herbert W Andrews, Eastman Kodak Co.*

Here is how an Industrial power plant, burning 1/3 million tons of coal per year on underfeed and chain grate stokers, outlines precautions taken to assure that units are prepared for use. This paper presents operators' informative, written, start up procedures with check sheets compiled in conjunction with equipment manufacturers to protect equipment and reduce hazards to operators during critical start up periods.

As an example, the following tests are indications of what precautions are expected after a prolonged outage:

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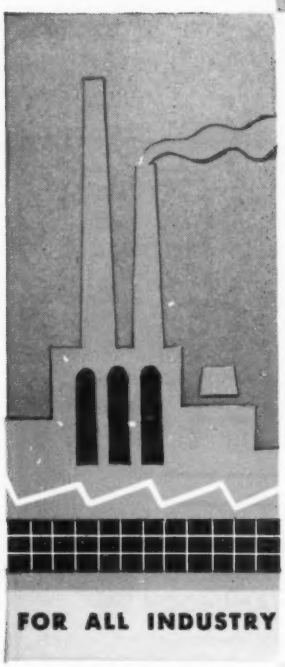

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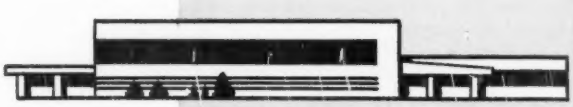

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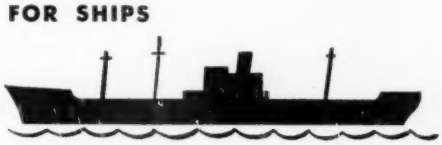

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More TECHNICAL BRIEFS

Begins on page 154

1. If handhole or manhole gaskets have been replaced or work done on any pressure parts give the unit a hydrostatic test with 70 F water at a pressure near the safety valve relieving point, using a portable compressed air-driven test pump of 5 gpm capacity. During this test, check blowdown valves for leakage, all valves for stem packing leakage and bonnet joint leakage, etc. Also inspect all pressure parts, tighten handhole and manholes and blow out impulse lines to pressure gages.

2. Pressure test the air heater for leakage after cleaning by operating forced draft fan and temporarily blanking air ducts to stoker.

3. Test the boiler setting, economizer and air heater casing, and air and gas ducts under 2½ inches of water pressure by operating the forced draft fan with the induced draft fan damper shut. Correct any leakage observed.

4. Operate the stoker for several hours applying maximum and minimum secondary ram-stroke and link-grate motions at various stoker speeds. Check and correct fasteners, moving parts and grease lines.

5. Place the forced draft and induced draft fans in operation on the combustion control system and run throughout the load range logging pressure and draft readings for comparison with previous data. Adjustments, if necessary, are made.

Further, each operator is given a manual of instructions pertaining to his job and to any other jobs for which he is trained. On the job training is performed by the experienced operators. A technically trained engineering staff is available to answer questions.

Starting up instructions taken from the operators' manuals are also made a part of the paper. An air starvation procedure instruction, also from the operators' manual, indicates procedure to be used in the event of a tube failure. Without instructions for reference, the operator would be handicapped by lack of opportunity to practice start-ups and could make costly errors. Instructions are revised as experience indicates a change is necessary or desirable. Trials are being made on reducing the start-up time of No. 11-14 boilers where five hours has been the rule. When a satisfactory procedure is perfected, revised instructions will be issued. *ASME Paper No. 53-F-18.*

Directions for ordering papers on p 156

Properties of Residual Petroleum Fuels. *By W Sacks, Ottawa, Canada.*

Although residual petroleum fuels

ELECTRICAL CODE DIAGRAMS

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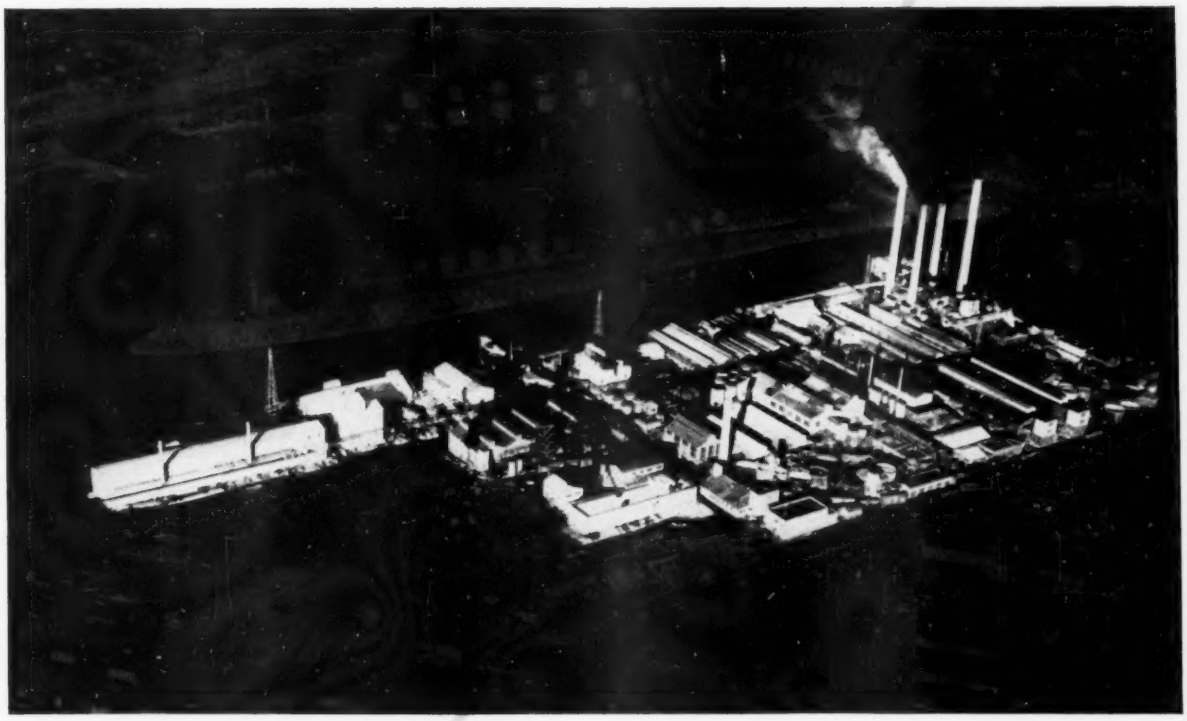

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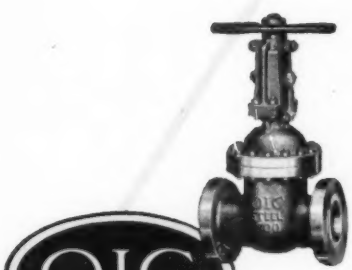

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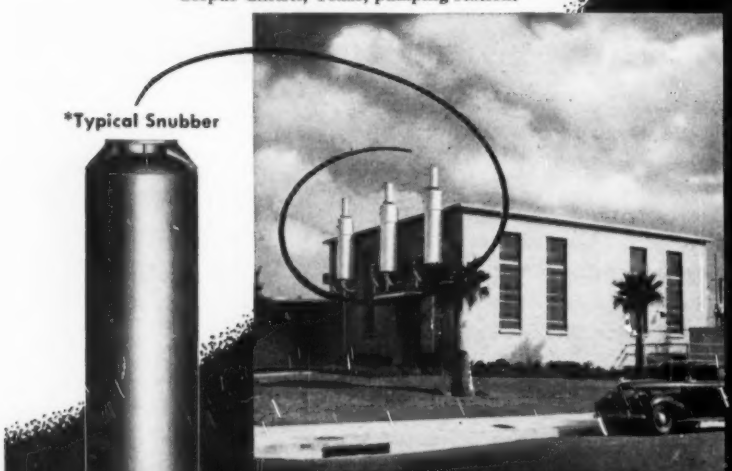

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More TECHNICAL BRIEFS

Begins on page 154

have been used extensively for many years, considerable confusion still exists as to their characteristics. As essentially cheap by-product fuels, they have not received a great deal of attention in the past. In recent years their use in gas turbines and diesel engines has emphasized the need for a better understanding of their properties and behavior in combustion chambers. The present paper brings together published information on the nature of residual petroleum fuels, widely scattered in petroleum and engineering journals. These fuels usually exhibit a more complex behavior than heavy-distillate fuels.

Specifications for use in naval boilers are more restrictive and, in addition to the properties listed in the foregoing, may limit pour point, specific gravity and carbon residue and may require thermal stability and compatibility tests.

No specifications for gas-turbine residual fuel have been published as yet. Much research is in progress and a good deal more operating experience is required. These specifications probably will resemble those for naval fuel with additional restrictions on vanadium and sodium. *ASME Paper No. 53-F-1.*

Station Design

Russell Station Reheat Unit, Design and Operating Experience. *By I G McChesney, Rochester Gas and Electric Corp.*

The first unit installed at Russell Station in December 1948 was of non-reheat design. Electric load growth in the Rochester area required the completion of a second unit two years later. During this interval, the first unit design was restudied and compared with a reheat design. Plantwise the increase in cost of the reheat cycle was small. Some of the items of cost, such as the turbine and increased amount of alloy piping were offset by the factor of increased efficiency. This increase in efficiency over the nonreheat cycle amounted to about 5%, and for a given station design output, it decreased the heat input requirements, reduced the size of auxiliaries, and the amount of auxiliary power. The overall aspect of the reheat cycle was favorable and such a design was developed for the second unit. E M Gilbert Associates were the consulting engineers for the design.

In the late '40's, there was a revival of the reheat cycle at temperatures ranging from 950 to 1000° F. This unit

(*Continued on page* 240)

Directions for ordering papers on p 156

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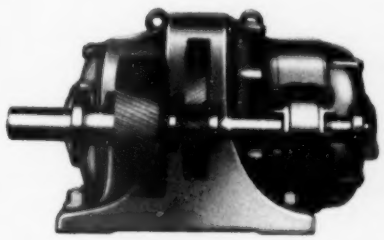

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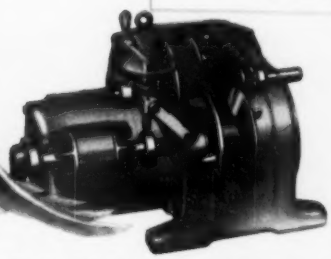

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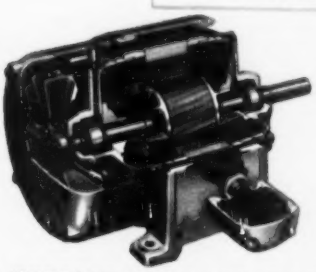

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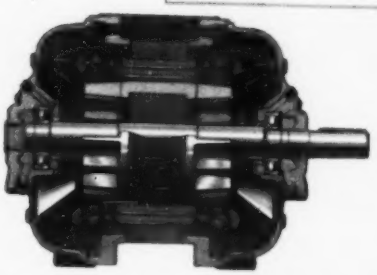

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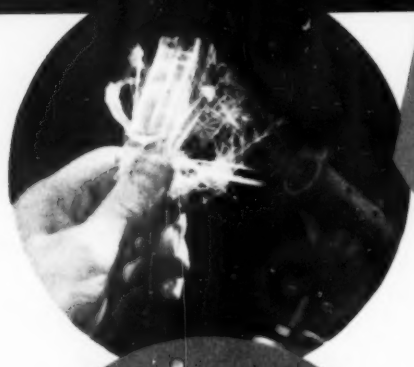

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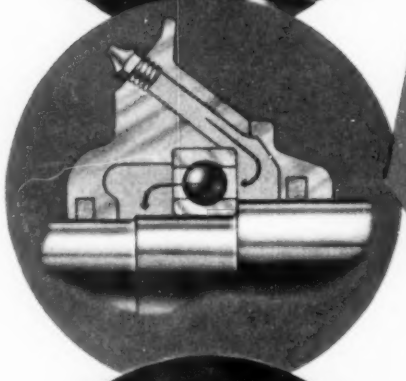

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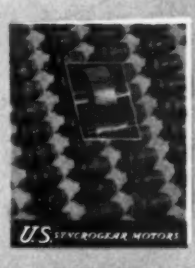

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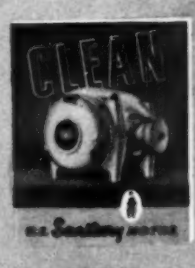

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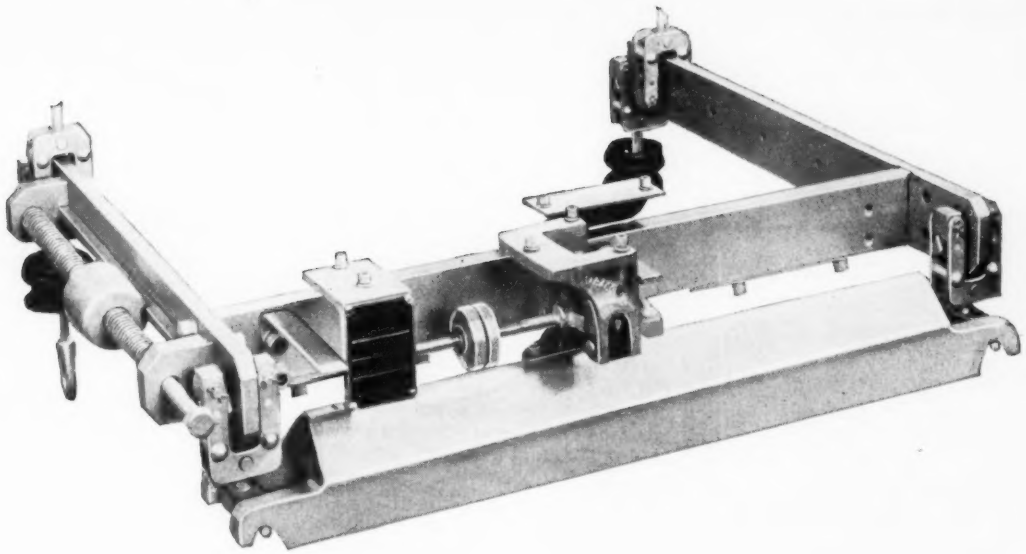

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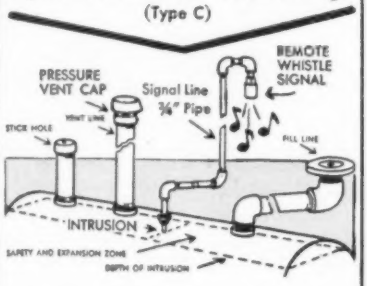

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More TECHNICAL BRIEFS

Begins on page 154

was one of the first of these high temperature installations, having a rated capacity of 50,000 kw and a capability of 67,000 kw. The throttle steam conditions were 1450 psi and 1000 F with reheating to 1000 F. System growth required an increase in the unit size and it was found that the reheat unit could be installed in approximately the same building volume as the first unit. A comparison of size and performance of the first two units is shown in the paper.

The overall operating efficiency of the plant is shown in Fig. 2. The plant performance reaches a net plant heat rate for No. 2 Unit of 9750 Btu per net kwh at 56,000 kw. For the year 1951 the average heat rate was 9935 and for 1952 it was 9990 Btu per net kwh. The higher rate in 1952 probably resulted from difficulties with the high pressure heater. A tube leak developed and, in the process of correcting the trouble, three high pressure heaters were out of service several weeks. Operating efficiency during the interval was 4½ per cent below normal. The normal expectation is an annual heat rate of 9950 Btu per net kwh. During early operation some difficulty was experienced in the regulation of throttle and reheat temperatures near maximum load operation. The source of the spray water had insufficient pressure to provide adequate desuperheating. A source of higher pressure was provided and spray nozzles enlarged to correct the difficulty. *ASME Paper No. 53-F-31.*

Directions for ordering papers on p 156

Design Considerations in Kodak Park's Power System. *By H A Decker, Eastman Kodak Co.*

This paper presents the design considerations for the power plant equipment in a highly specialized chemical plant producing photographic film and paper products. High pressure boilers and turbines are used to produce the steam required by the manufacturing plant and generate electrical power on a by-product basis. The nature of the manufacturing processes requires that special attention be given to continuity of operation and plant cleanliness.

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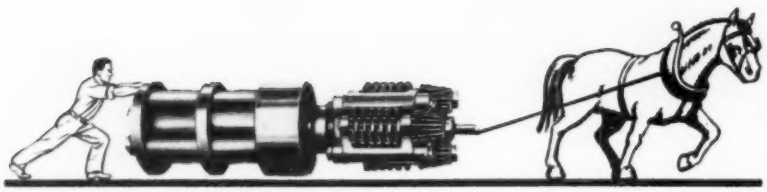

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More TECHNICAL BRIEFS

Begins on page 154

tion, since Kodak Park extends over considerable area. We have two power houses about a mile apart, but the Bldg 101 plant, located in what is called Kodak Park West, is inadequate to supply the full requirements of the western sections of Kodak Park and the deficiencies are made up from the Bldg 31 plant, located in Kodak Park East, which is the larger of the two and has the newest equipment. There is a 12 in. pipe line transmitting at 260 psi. to Bldg 101 with an extension to the area still further west, a mile and a half from Bldg. 31. We are now in the process of supplementing the 12-in. main with a 5,000-ft., 20-in. pipe line to supply steam for the new turbine previously mentioned and also, expected increases in load in the western areas of the plant.

The distribution mains radiate from each of the two power plants to take care of process and heating loads. The nominal steam pressure of these mains is principally 70 psi or 5 psi. A 4,000-ft, 36-in. main is being planned, also in conjunction with the new generating unit, to convert the sizable load of a gelatine plant to low-pressure steam service as a means of improving heat balance. Because of the distance involved, the transmission pressure in this case will be somewhat higher than 5 psi.

Although the primary aim of our power plants is to supply steam for process and heating, electrical generation is of almost equal importance. The power produced, however, is a byproduct of the steam plant. Boiler capacity is not installed simply for the making of power, although the incremental capital expenditure for higher pressure and temperature rating and the incidental equipment caused by power generation are made to stand on their own merit.

The steam required in the plant integrates to a reasonably steady demand from the boilers. During non-factory hours and weekends, the demand drops off to 75%. The summer steam load is approximately 75% of the maximum winter loads. On this type of steam demand the electrical requirements are obtained as far as possible from the theoretical heat equivalent. Practically considering boiler and turbine efficiencies, this is about 4200 Btu measured from the coal pile.

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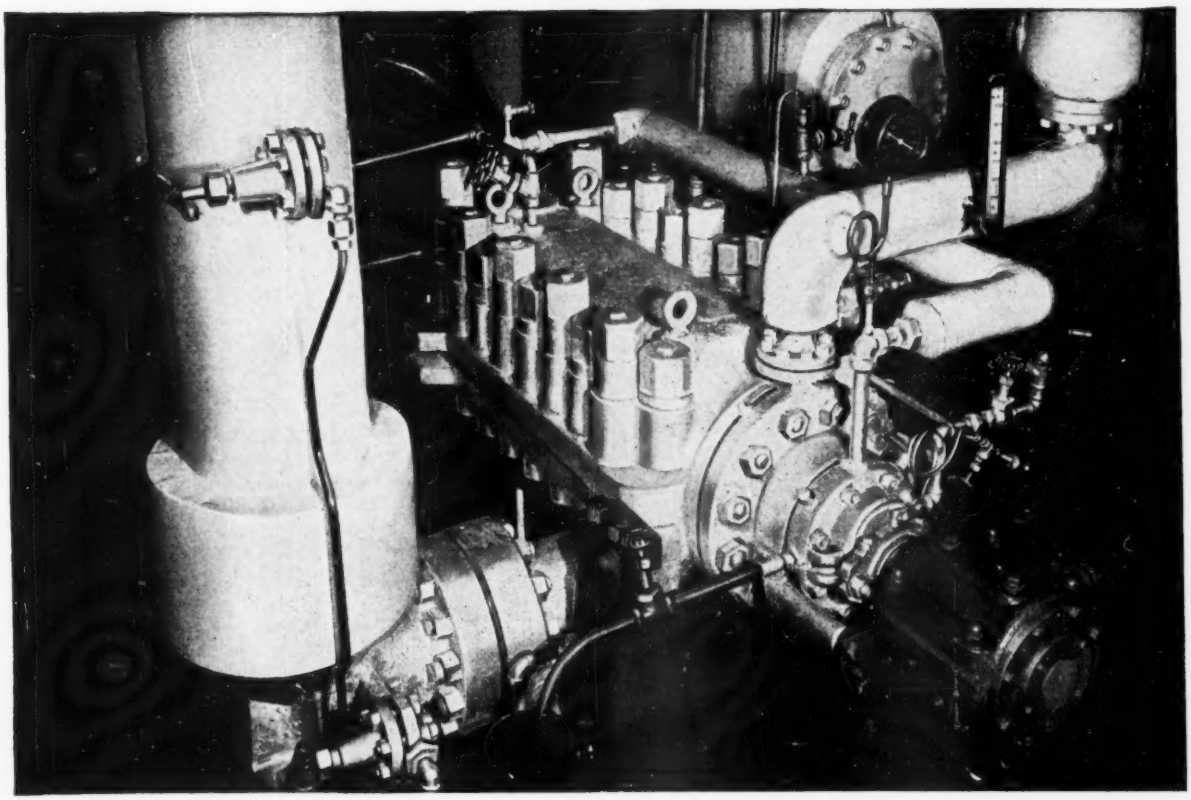

This Ingersoll-Rand High Pressure Boiler Feed Pump installed 15 years ago has never been opened for inspection . . . and it still meets capacity and pressure requirements.

The Ingersoll-Rand Class HT pump shown above was installed in 1938 at the Windsor Station, owned jointly by The Ohio Power Company (part of the American Gas & Electric Company) and the West Penn Power Company (in the West Penn Electric Company system). Since that time, it has operated for over 100,000 hours—pumping 1025 gpm of 380° F boiler feed water at 415 psi intake and 1900 psi discharge. Throughout this entire 15 year period, the casing and high pressure breakdown have never been opened for inspection.

There are five other I-R Class HT pumps at this station. Four of these have chalked up unopened service records of from 50,000 to 80,000 hours each.

These outstanding operating records are the result of competent pump operation and feedwater control on the part of the station's personnel—and the careful material selection and high standards of construction inherent in every I-R boiler feed pump.

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RIDGID
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More TECHNICAL BRIEFS

Begins on page 154

same as the steam load from day to night. The growth of electric load has, however, been such that the summer peak of one year is the same as the following winter peak.

In the past 20 years, the increase in electrical use has been much greater than the increase in steam demand. Steam use has been doubling about every 15 years and, during this same period, the electrical use has been doubling about every 11 years. In common with the rest of the country, the manufacturing plant has been going through a period of rapid mechanization.

In the past 30-year period, the operating pressure of the boilers has been raised successively from 135 psi to 260 psi to 800 psi., in order to obtain increasing amounts of power from the steam output. The steam temperature of the newest boilers was increased from 750 F to 825 F to obtain a 6% increase in power. We are currently studying the possibility of 1400 psi and 900 F for the next addition to capacity. Incidentally, our acceptance of higher pressure and temperature follows, generally speaking, by 10 years its use by the utilities. We are not in the power business as such and we do not feel justified in pioneering in metallurgy or radically new boiler and turbine designs.

In adding new capacity, available space for expansion has been an important consideration in design. Surrounded on all sides as we are by a plant manufacturing sensitized products, we are forced to budget the space in order to reserve room for future installations. Consideration of the cost of steam distribution, operating labor and duplication of auxiliary equipment dictates that we develop on present sites as long as possible. This lack of space has caused us to build high power houses, and to place our fan and piping systems above the boiler.

Lack of space has been of a somewhat deterrent to utilizing some of the outdoor and semi-outdoor features which many of the newer plants have. In this regard, it has been our feeling that high speed equipment in elevated locations should be housed for ease of operation and maintenance. On the ground, this equipment would be satisfactory in the open.

To save space as well as to reduce unit installation and operating labor costs, we are currently studying the possibility of larger-sized units. There are a considerable amount of replacements to be made over the next 10 to 15 years. With new load and with continu-

meet the man who

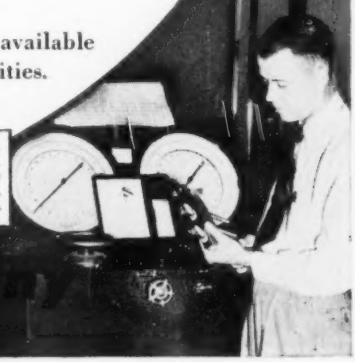
Predetermines Performance of MARLEY COOLING TOWERS

He is Donald R. Baker, who directs Marley cooling tower performance-research and testing. Mr. Baker and his staff of associate engineers have changed the standard of measurement for cooling tower rating from a yardstick to a micrometer. Their achievements offer a very tangible benefit to every Marley customer: the assurance that all Marley cooling towers will meet or surpass specified design performance.

Positive predetermination of cooling tower performance is the result of more than a decade of effort by this Marley research group. The project has required the cumulative knowledge of many specialized engineering skills possessed by members of this department. Their approach has been both scientific and practical. Every theory developed has been proven in the Marley cooling tower test plant—industry's first and always the most complete installation of its type. Services of independent research and test organizations have been used liberally to further prove the practicality of every effort.

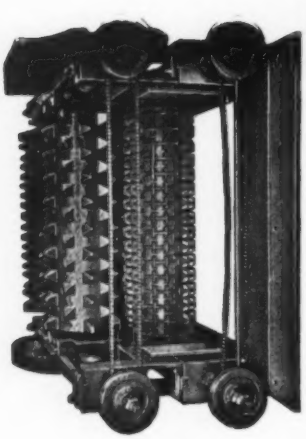
The published results of Marley test research are available through Marley engineering sales offices in 50 cities. Just ask for Technical Bulletin R-52-P10.

Other Marley research projects: WOOD DETERIORATION AND PRESERVATION, CORROSION OF METAL, PROTECTIVE COATINGS, METALLURGY, LUBRICATION AND OTHER OPERATIONAL PROBLEMS, MATERIALS SELECTION. Literature or information available on all subjects.



The Marley Company

Kansas City, Missouri



TWO STAGE – DOUBLE ADJUSTMENT

Crusher is pictured without hopper and sprocket guards, but is delivered complete.

WRITE TODAY FOR CRUSHER BULLETIN P-3

Two Stage CRUSHING IN ONE MACHINE!

"Two Stage" Coal Crusher incorporates two crushing stages in one machine and is designed to reduce RUN-OF-MINE to STOKER COAL in ONE operation. Compact design simplifies structural supports and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit.

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% usable stoker coal from an Illinois mine run lot.

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

T. J. GUNDLACH Machine Co., Belleville, Ill.

More TECHNICAL BRIEFS

Begins on page 154

ally rising cost of material and labor, larger equipment appears to be the best way of keeping unit capital and operating costs down. *ASME Paper No. 53-F-8.*

Directions for ordering papers on p 156

Electricity

Grounded Versus Undergrounded Low-Voltage AC Systems. *By H B Thacker, Westinghouse Electric Corp.*

Early industrial-plant distribution systems were almost all operated with the neutral insulated. This permitted operation with a ground on some device or part of the circuit. Also, the use of 440 or 550-v power-supplied from delta-connected transformer banks and the higher cost of wye-connected three-phase transformers with the neutral available for grounding discouraged the use of three-phase four-wire grounded-neutral distribution systems.

There has been a decided trend toward grounding low-voltage systems in industrial plants in the last ten years. Some reasons for this are: (1) More positive location of ground faults by tripping out only the affected circuit, and (2) reduction in the possibility of multiple failures of equipment and circuits from overvoltages resulting from ground faults.

Both of these reasons have assumed greater importance with the tremendous growth in industrial systems and electric power use. A third reason tending to increase the use of grounded systems has been the development and use of higher-voltage lighting supplied at 265-v. This makes attractive the use of three-phase, four-wire, 460 and 265-v wye-connected distribution systems.

This paper discusses advantages and disadvantages of grounded and ungrounded systems bringing out that, in general, neutral grounding is preferred, but that under certain operating conditions there are many applications where the ungrounded system provides an additional and highly desirable degree of service continuity. Methods of grounding both new and existing systems are discussed. *AISE paper. No number.*

Cathodic Protection of Mill Grounding Systems. *By J F Headlee, United States Steel Corp.*

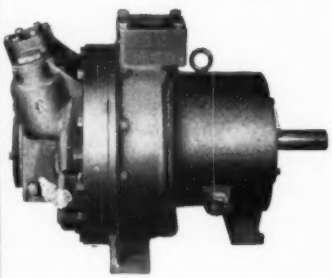
Great improvements have been made in circuit and equipment grounding systems. Two sources cause electrolysis in such a system: stray currents from dc generators and galvanic currents from two unlike materials in electrolyte.

For **QUALITY** *Specify*

PYLE-NATIONAL

Turbines

¼ to 120 h.p.



The Pyle-National line of highly efficient impulse type turbines is ideal for dependable mechanical drive of small machinery such as pumps, fans, blowers, stokers, abrasive wheels, agitators, and generators particularly where the exhaust steam can be used for heating and other purposes.

Since 1897 Pyle-National has manufactured their turbines entirely within their own plant . . . thus assuring positive control of quality and workmanship through all stages of production . . . from raw material to the final testing.

SEND NOW FOR BULLETINS containing complete information on these small and medium capacity turbines.

TURBO-GENERATORS

Also available is bulletin on Pyle-National turbo-generators (500 to 15000 watts).

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HI-LO LIMITORQUE.

2 SPEED AUTOMATIC VALVE OPERATOR

..helps to prevent SURGE or HAMMER during closure of valves..

The name *Limitorque* has been for years synonymous with dependable MOTORIZED VALVE OPERATION in Refineries, Pipe Lines, Power Plants, Water and Sewage Works . . . throughout the World.

Now, a device is available for use with *Limitorque* which permits a valve to be *operated at 2 different speeds*. This device, known as the "HI-LO" attachment permits the speed of the valve stem to be VARIED AT ANY PRE-DETERMINED POINT . . . or if required, the valve may be opened at one fixed speed and closed at another pre-determined speed.

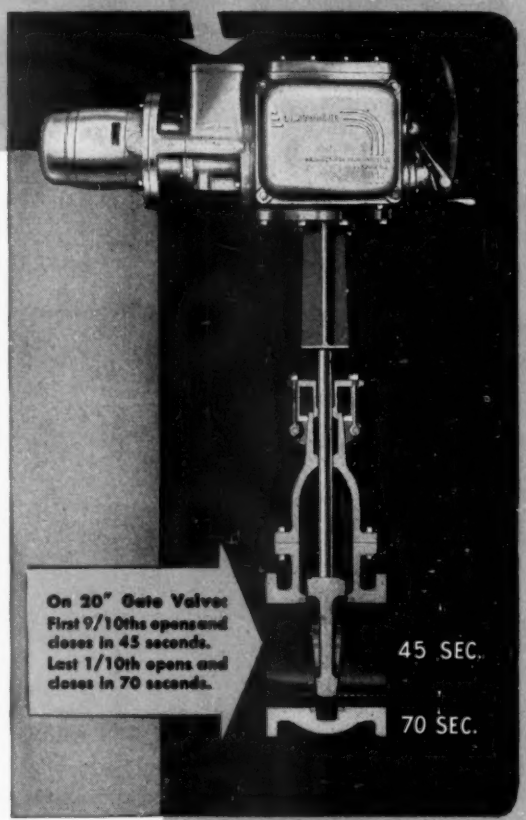
"HI-LO" is a device which prevents:

- DAMAGE to valves and station pumps.
- BREAKS in pipeline caused by "surge".
- DAMAGE to expensive equipment.
- INJURIES to personnel.

"HI-LO" is a device which minimizes or completely eliminates:

- LINE "SURGE" OR "HAMMER" during closure.
- NECESSITY OF BY-PASS VALVES because of greatly increased torque during initial valve opening.
- ELEMENT OF HUMAN ERROR, to a great extent, in operation.

The 2-Speed "HI-LO" is new, different, exclusive, and when combined with *Limitorque*, gives simple, positive, automatic and safe motorized valve operation.



Above illustration shows a 20" Gate Valve with first 9/10ths of travel closed in 45 seconds—and last 1/10th of travel to close in 70 seconds. However, change from high to low speed can be made at any pre-determined point of travel. Operation can also be fixed to obtain one speed closing, and one speed (either faster or slower) in opening of valve.

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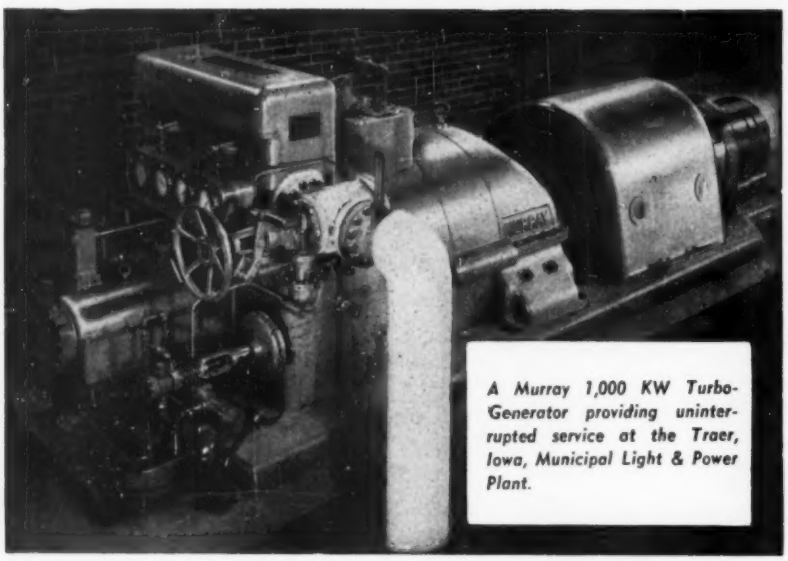

A Murray 1,000 KW Turbo-Generator providing uninterrupted service at the Traer, Iowa, Municipal Light & Power Plant.

● A typical, modern, small public utility is the Municipal Light and Power Plant at Traer, Iowa. This plant supplies water, steam heat and electric power to the community and surrounding countryside. The Murray turbo-generator pictured above carries the full electrical load of the plant and supplies the steam for heating by automatic extraction at 10# gauge pressure.

The simplified design and rugged construction of this and all MURRAY turbines particularly adapt them to this or any other drive where long life, reliability and low operating costs are a *must*.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

More TECHNICAL BRIEFS

Begins on page 154

Since the primary purpose of a ground system is to limit the rise of potential on a circuit during a fault, it is necessary that the resistance to earth be kept low by suitable electrodes. The design and installation of the grounding systems at the U. S. Steel Corp's Fairless Works is described as a typical case of cathodic protection. When developing this system, soil samples were tested which gave resistance readings of 22,500 to 28,000 ohms per cm.

Because of the earth's high resistance, steel rods 40 ft long 1½-in. in diameter were driven into the earth to a point where better conductivity was found. Each pair of these rods was protected by a 10-ft long, 4x4-in. square magnesium anode rod cast on the center of a 20-ft long, 1-in. diameter steel rod. It is believed the steel ground rods with this cathodic protection will last indefinitely and that the magnesium anodes should last about 20 years. *AISE paper. No number.*

More FREE BULLETINS

Begins on page 167

color, 4-page folder. Photos, sketches, engrg data, model and application specs. Bulletin 5101A, Heinemann Electric Co, 371 Plum St, Trenton 2, N. J.

14 **Silicone products** application index, comprehensive and cross-referenced. Old listing expanded to include three new categories, 15 new products ranging from adhesives to molding compounds. Dow-Corning Corp, Midland, Mich.

15 **Totally - enclosed,** fan - cooled, high-slip induction motor for punch press service. Two-color, 4-page folder. Photos, cutaways, dimensional drawings, full specs. Bulletin GEA-5968, General Electric Co, Schenectady 5, N. Y.

16 **Current limiting,** cast-in-concrete reactors for single and 3-phase circuits of 34,500 v and below. Two-color, 8-page catalog. Application photos and data. Bulletin GEA-976C, General Electric Co, Schenectady 5, N. Y.

17 **New manual,** *Operation and Maintenance of Dry-type Transformers,* written as guide for management, electricians and maintenance personnel in proper installation and care of equipment. Ten pages, illus, engrg data. Manual T2, Hevi Duty Electric Co, Milwaukee 1, Wis.

18 **Aluminum for power** and lighting wire, its uses and properties including current-carrying capacity, comparison of weights, breaking strength, etc. Thirty-page handbook, United States Rubber Co, Electrical Wire & Cable Dept, Rockefeller Center, New York 20, N. Y.

HEAT EXCHANGERS

19 **Fully automatic,** heavy fuel oil burners. Two-color, 8-page folder. Photos, capacity ratings, construction features. Brochure A-604, Ray Oil Burner Co, 1301 San Jose Ave, San Francisco 12, California.

20 **Standard method** for testing hot water unit heaters so as to assure

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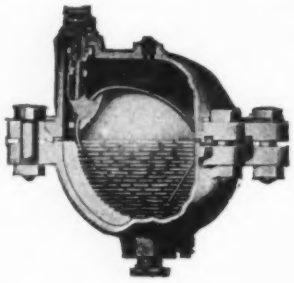
GET RID OF AIR ACCUMULATIONS IN PIPE LINES...



a BIG Trouble Saver that Costs You LITTLE!

When air lodges at high spots in pipe lines, it reduces the effective area of the pipe, creates a friction head, lowers pumping capacity, and may result in serious water hammer!

Simplex Air Release Valves bring you a sure, efficient cure for these difficulties . . . venting air *automatically before it can cause damage.*

The Simplex Air Valve is easily installed . . . positive in action . . . ample in capacity. Standard valves for pressures up to 250 p.s.i. . . . special valves for pressures up to 800 p.s.i. Thousands have been in successful use for over 30 years.

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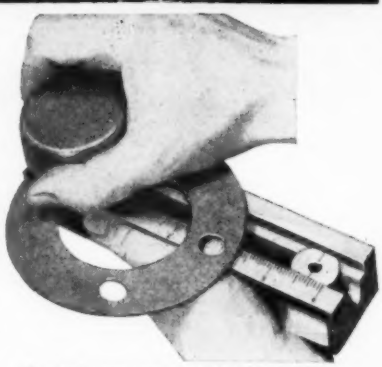

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Begins on page 167

proper capacity ratings. 20-page, illus booklet. Bulletin 11, Industrial Unit Heater Assn, 2159 Guardian Bldg, Detroit 26, Mich.

21 **Cyclonic combustion,** a new principle in heat transfer that cuts down heating surface to three sq ft per boiler horsepower. Two-color, 4-page pamphlet, *All Your Questions Are Answered By Cyclotherm,* Cyclotherm, Oswego, N. Y.

22 **Horizontal rotary** oil burners, combination oil-gas burners, and forced-draft packaged burners for oil and combination oil-gas firing. Two-color, 16-page catalog. Cutaways and full data on models and capacities. Catalog 5052, Iron Fireman Mfg Co, Cleveland 11, Ohio.

23 **Baffle, spray-type,** feedwater heaters that operate silently and have no loose gadgets, baffles or trays to remove for cleaning or repair. Two-color, 4-page folder. Photos, cutaways, operation data. Bulletin S-217, Stickle Steam Specialties Co, Indianapolis 18, Ind.

MATERIALS HANDLING

★ **Belt conveyors** and accessories. Illus catalog containing sixty pages of typical conveyor layouts and installation photographs. Catalog 76A. ★Request direct on company letterhead to Barber-Greene Co, 400 N Highland Ave, Aurora, Ill.

24 **Hand and electric** hoisting equipment. Twelve - page bulletin titled, *There's a Yale Hoist for Every Lifting Job.* Illustrations, application data. Bulletin 1567, Yale & Towne Mfg Co, Yale Materials Handling Div, Philadelphia 15, Pa.

25 **Cast malleable** and Promal elevator buckets for handling such diverse materials as coal, coke, ores, cement, chemicals, etc. Two-color, 12-page catalog. Photos; tables of dimensions, weights and capacities for 55 standard sizes; detailed information on mounting procedures. Book 2465, Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

MECHANICAL TRANSMISSION

27 **Stock gears,** speed reducers, sprockets and chains, couplings and special gears. 175-page catalog. Photos, dimensional sketches, 40 pages of tables and engrg data. Grant Gear Works, Inc, 154 W 2nd St, Boston 27, Mass.

28 **Fluid drives** for adjustable speed operations in the 100 to 2500-hp range. Two-color, 24-page bulletin. Photos, schematic diagrams, performance curves, full specs. Bulletin 9319, American Blower Corp, Detroit 32, Mich.

★ **Technical manual** on all elements of V-belt drives. 52 pages. Tables, graphs, diagrams. ★Request direct on company letterhead to Boston Woven Hose & Rubber Co, Dept 609-26, Boston 3, Mass.

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30 **Packaged** adjustable - voltage drives for variable speed applications and case histories taken from machine tool, textile, and continuous processing industries. 16-page booklet. Construction and operational data. Booklet B-5808, Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

31 **Rigid, adjustable-type** belt idlers for V-belt drives or flat belts. Illus, 14-page catalog. Full specs. I G Downs, Inc, 1542 Blake St, Denver, Colo.

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32 **Selection,** installation and connection of watthour meter sockets for all applications. 20-page reference publication. Photos, installation dia-

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PANELLIT maintains a separate Power Division with engineers specifically experienced in the design and installation of controls for the Power Industry. And, since PANELLIT is not an instrument manufacturer, it can be completely unbiased with respect to engineering assistance as well as the selection of controls for each phase of your system.

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Installation shown is the Central Control Room at the Edge Moor Station of the Delaware Power and Light Company, engineered and installed by United Engineers and Constructors, Inc., Philadelphia, Pa.

Prefabricated entirely by Panellit, Inc., the four-wall control panel forms the control room. An inner wall is the control panel front on which the instruments are mounted; the insulated outer wall serves as the outside wall of the control room and holds all contactors and electronic equipment associated with the combustion control.

LITERATURE WILL BE SENT UPON REQUEST.

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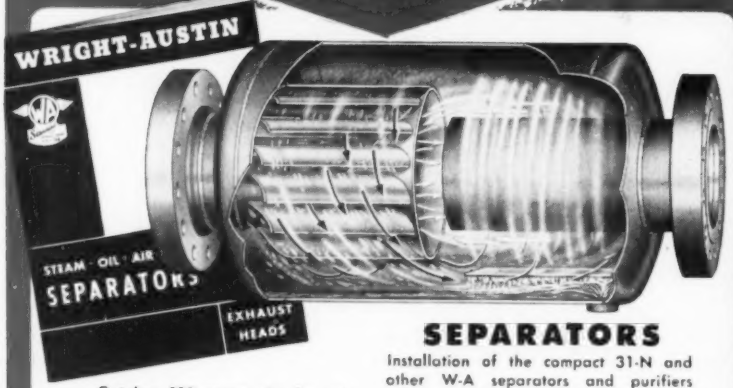

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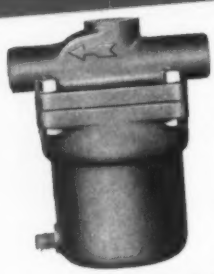

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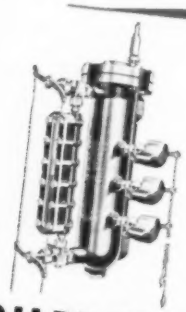

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grams, full specs and application data. Bulletin GEA-5878, General Electric Co, Schenectady 5, N. Y.

33 **Dial thermometers** for long distance measurement of process variables. Two-color, 16-page booklet. Photos, installation diagrams, complete specs. Bulletin 467, Foxboro Co, Foxboro, Mass.

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38 **Instrument** for rapid and precise multiple indication of any variable that can be transformed to millivolts. Illus, 8-page booklet. Bulletin 1541, Minneapolis-Honeywell Regulator Co, Wayne and Windrim Ave, Philadelphia 44, Pa.

39 **High-frequency** pressure cells for measuring rapidly changing pressures up to 20,000 psi. Illus leaflet with full specs. Bulletin 4107, Baldwin-Lima-Hamilton Corp, Philadelphia 42, Pa.

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40 **Data booklet** on selection and sizing of pressure relief valves to comply with ASME Boiler Code requirements. 24 pages. Complete data for accurately determining output of all types of boilers, tanks and heaters. McDonnell & Miller, Inc, 3500 N Spaulding Ave, Chicago, Ill.

41 **Low pressure** gas valves carrying UL approval for 400 lb WOG pressure rating. Two-color, 4-page folder. Photos, cutaway views, full specs. Fairbanks Co, 393 Lafayette St, New York 3 N. Y.

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46 **Flont and lever** valves. Two-color, 16-page catalog. Cutaway photos, sectional and dimensional drawings, engrg data, complete specs. Catalog 107, Schade Valve Mfg Co, 2527-37 N Bodine St, Philadelphia 33, Pa.

47 **Steel pipe** and tubing for high-temperature service in oil refining and power industries. Two-color, 6-page folder. Complete data for series

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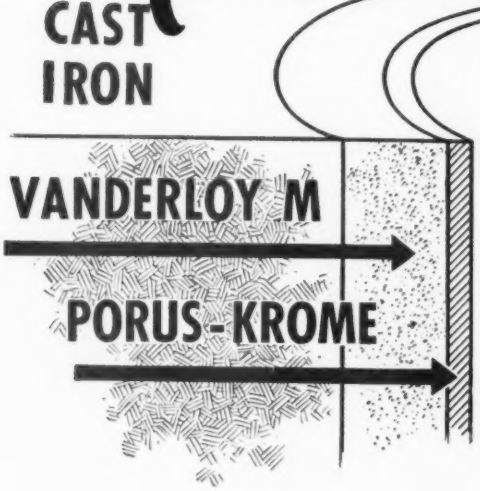

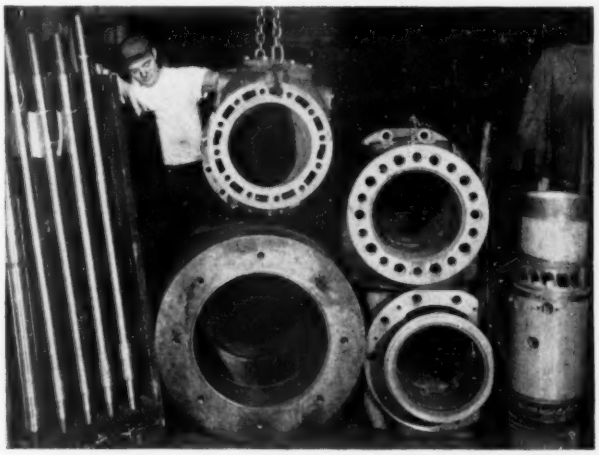

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With VANDERLOY M we can plate back any liner you have to original size — and with PORUS-KROME* we can keep it that way.

A PORUS-KROME liner outwears as many as four unprocessed liners. Meantime, it uses less lube and fuel oil, delivers more power and is much easier on rings.

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Of course the real profit comes when you eliminate the cost of stocking oversize parts — simply by having Van der Horst "reverse the wear" on all your liners. Let us show you how much can be saved by making this your standard practice.

W52-3D

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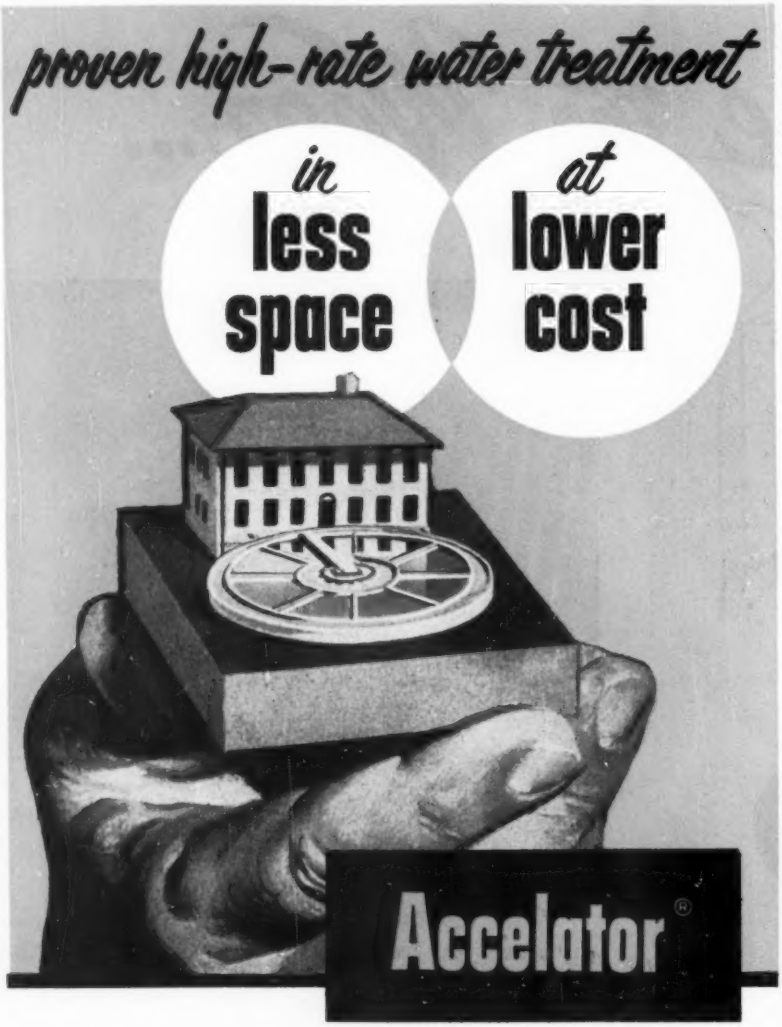

The Accelator combines – in a single unit – mixing, coagulation and solids separation. It occupies a fraction of the space required by other types of conventional plants and greatly reduces installation costs. Softening, clarification and stabilization plus highly efficient algae and bacteria removal are obtained at the highest flow rates because of the Accelator's slurry recirculation and dynamic separation. For full details send for your copy of the informative 28-page Accelator bulletin.

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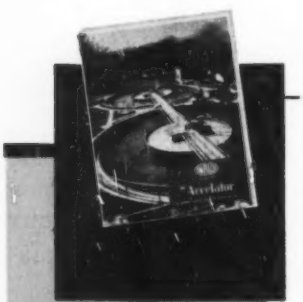

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More FREE BULLETINS

Begins on page 167

of tubing ranging from plain low-carbon steel to 25%-chromium, 20%-nickel stainless. TDC 163, Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

48 **Pop safety** and relief valves for steam air, gas, water, oil and other fluids. Two-color, 12-page catalog. Photos, cutaways, full specs. Circular 502, Lunkenheimer Co, Box 360, Cincinnati 14, Ohio.

PRIME MOVERS & ACCESSORIES

49 **Diesel engines** in six sizes for industrial, marine and electrical applications. Two-color, 8-page, illustrated application booklet. Caterpillar Tractor Co, Peoria, Ill.

50 **Superchargers** for internal combustion engines, blower and air compressor operations. Two-color, 4-page folder. Photos, specs, tables and graphs. Bulletin 153, Miehle-Dexter Supercharger Division, Dexter Folder Co, Racine, Wis.

51 **Diesel engines** in sizes from 2550 hp, 1800 kw to 6150 hp, 4400 kw for municipal power plants, central stations and industrial plants. Two-color, 8-page booklet. Photos, sectional drawings, specs. Bulletin 224A, Nordberg Mfg Co, Milwaukee 1, Wis.

PUMPS

52 **Condensed booklet** on products and applications of Worthington line. Two-color, 24-page, illus catalog. Worthington Corp, Harrison, N. J.

53 **Controlled - volume** "miniPumps" for accurate pumping of minute quantities. Two-color, 10-page booklet. Photos, cutaways, full specs. Bulletin 653, Milton Roy Co, 1300 E Mermaid Lane, Philadelphia, Pa.

54 **Multi-stage centrifugal** pumps for heads up to 650 psi and capacities from 50 to 850 gpm. Two-color, 8-page bulletin. Photos, cutaways, sectional and dimensional views. Bulletin 237-C, Pennsylvania Pump and Compressor Co, Easton, Pa.

55 **Mechanical seals** for centrifugal pumps, their application, operation and maintenance. 16-page bulletin. Application photos and sectional views. Bulletin 153-10,000, Byron Jackson Co, Pump Division, Los Angeles 54, Calif.

WATER TREATMENT

56 **Contact reactor** for clarifying and/or softening of water. Illus booklet, specs and application details. Publ 5001-A, Cochrane Corp, 17th St below Allegheny Ave, Philadelphia 32, Pa.

57 **Automatically controlled** feeding of sulfuric acid and sodium dichromate and continuous blowdown regulation using recording and indicating *ElectroniK* patentiometer with *Air-O-Line* control. Illus Data Sheet No. 9.6-7, Minneapolis-Honeywell Regulator Co, Wayne and Windrim Ave, Philadelphia 44, Pa.

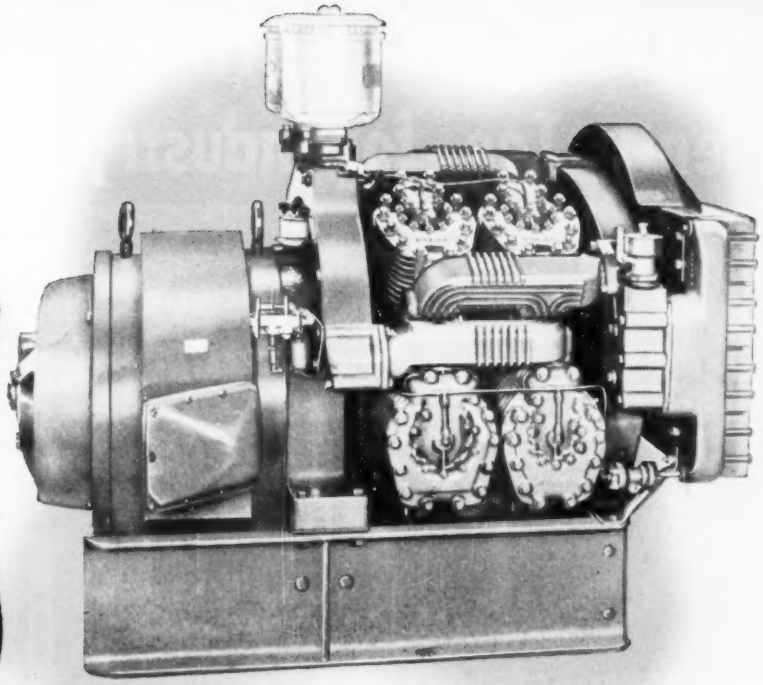
58 **Information** on factors involved in obtaining useful samples required for proper control of water conditions in a power house. Four-page, illustrated folder. Leaflet 28X7969, Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

MISCELLANEOUS

59 **Consumable - electrode** welding equipment and processes. Two 8-page illustrated booklets showing application techniques. Bulletins GEA-6028 and GER-819, General Electric Co, Schenectady 5, N. Y.

60 **Conveying systems** for handling cement, pulverized coal, limestone dust, flyash, pulverized rock, etc. 16-page bulletin. Installation photos, dimensional sketches, detailed application descriptions. Bulletin FK-26, Fuller Co, Catasauqua, Pa.

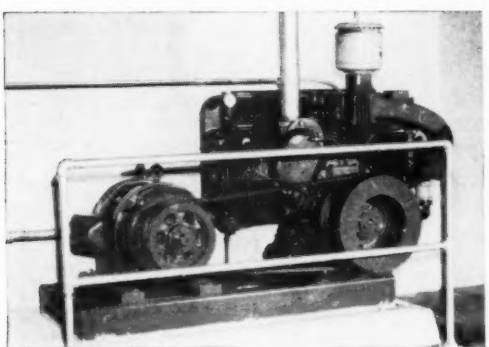
JOY WL-80 COMPRESSOR with automatic start and stop control



A Real "Package-Unit"

Joy WL-80's are ideal for the smaller air-requirement jobs, or for de-centralized air supply, etc. These two-stage, air-cooled units are delivered ready-to-go, complete with air receivers, piping and wiring if you wish—just hook them up to power and air lines. Extremely compact and efficient, a WL-80 will fit into any small corner of your plant. You can eliminate long runs of piping; compress the air right where you use it. Available in eleven sizes from 15 to 125 HP, 81 to 641 CFM, with pressures to 125 PSI, for service indoors or out. ● *Write for Bulletin A-56.*

Joy also makes a complete line of Oil-Free Compressors for applications where air must be free of any lubricant. *Write for details.*



JOY COMPRESSORS **meet any need!**

Air-cooled or heavy duty water-cooled; complete range from 1.4 to 8800 CFM, ¼ to 600 HP.

Consult a Joy Engineer

Over 100 Years of Engineering Leadership

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JOY MANUFACTURING COMPANY

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MILLIONS for the NAVY Plenty, Too, for Industry

AJAX
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GASKETS

Uncle Sam's Navy is a critical buyer and a tough proving ground for any product.

If they're good enough for the Navy, you can be sure AJAX Spiralwound Gaskets are the Gaskets you want.

Get the Gaskets with built-in resilience for safer seals with lighter bolt-loads. The Gaskets that "breathe" with varying pressures and temperatures to keep joints tight under all operating conditions. The thrifty Gaskets that can be reused because they don't lose their resiliency under compression.

Types for all standard flanges and for stationary and marine boilers and accessories. Made of plated low-carbon steel or stainless with fillers of Canadian or Blue African Asbestos.

Industrial Distributors stock them for your convenience. Ask yours or write—

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FABRICATORS OF "TEFLON" & "KEL-F" FOR THE CHEMICAL PROCESS & ELECTRONIC INDUSTRIES
CAMDEN 1 NEW JERSEY

Representatives in Principal Cities Throughout the World

My Biggest Boner

► THOUGH this happened on a ship, many shoreside engineers and designers may get some good ideas from it.

Our ship, a large passenger vessel, pulled into 'Frisco for repairs and refueling. The second night in port an oil tanker came alongside with our fuel oil. We tied her up to our starboard side.

I opened the loading valves and gave the engineer on the tanker the signal to start pumping. Then I sat back to relax before making my first round for soundings. I'd just settled myself comfortably when the quartermaster on watch came bouncing down the ladder yelling, "Mister, you're lousing up the harbor with fuel oil!"

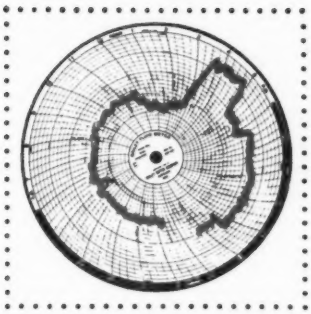
I yelled to the tanker engineer to stop his pumps. Then I shut our loading valves. The quartermaster hung around until the valves were shut and then led me to our port side. Sure enough, the oil was there, polluting the harbor water.

It took me awhile to learn how the oil got into the harbor instead of our tanks, but this is what happened: the last time we'd refueled was in Hawaii, on the port side. But the engineer on watch forgot to close his loading valves, so in 'Frisco, the oil just flowed into the manifold on the starboard side, out on the port.

I caught the dickens but personally saw to it that check valves were installed on each side of the manifold before we sailed.

ARNOLD DE GROES
New York, N. Y.

• What is your "biggest boner"? We'll pay ten dollars for each one we publish.



another major utility

KEARNY Generating Station

Public Service Electric and Gas Co.

SELECTS PEABODY

Public Service Electric and Gas Company, keeping pace with the rapidly progressing power generation field, recently placed their new Kearney #7 unit in service. This unit is the *first* to use steam temperature of as high as 1100 F and turbine throttle pressure of 2350 PSI. Provided with Peabody Wide Range Mechanical Atomizers and Constant Differential Pump Systems, this Kearny Unit is getting a load range of 7 to 1 – with all burners in service and no changing of tips!

OFFICES IN PRINCIPAL CITIES

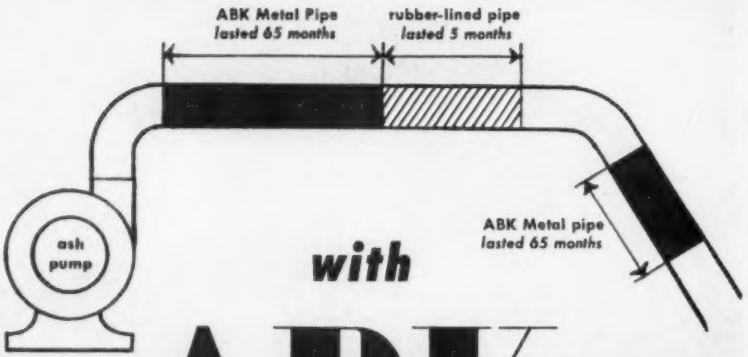
PEABODY
ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 36, N. Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers.

514

PEABODY LIMITED • LONDON, S.W. 15, ENGLAND

MORE than 10 TIMES the LIFE

in this ash system test



with

ABK METAL

THIS ash removal system was installed five years ago in a Midwestern power station. More than 100 feet of ABK Metal pipe and rubber-lined pipe were specified for the purpose of a comparison test. Results serve as one more illustration that ABK Metal outlasts other types of abrasion-resistant materials. For ABK Metal gave *thirteen times* the life of special rubber-lined pipe.

So the evidence keeps rolling in that ABK Metal is the most economical material for handling abrasive ash. Savings on replacement parts plus reduction in down time and maintenance add up to really worthwhile operational economies. ABK Metal minimizes the destructive wear of abrasive ash and clinker because of the controlled, uniform structure and extreme hardness of this nickel-chrome iron.

Don't let wet or dry ash abrasion steal your operating dollars. Specify castings in ABK Metal, an exclusive Brake Shoe product.

QUALITY CASTINGS IN ABK METAL.. MEEHANITE... DUCTALLOY

Chicago Houston St. Louis San Francisco Toledo

1744

AMERICAN Brake Shoe COMPANY

BRAKE SHOE AND CASTINGS DIVISION
230 Park Avenue, New York 17, N. Y.

More POWER NEWS

Begins on page 152

an all-out attack on our nuclear power program immediately, we may be deprived of foreign uranium ores with the result that our weapons potential will be smaller than need be the case. And so the two races—the atomic arms race and the nuclear industrial power race are strangely related.

"Once it is accepted that our uranium supply may be, to some extent, dependent on early success in the power race, it should be quite clear that the stakes are high. Once we become fully conscious of the possibility that power hungry countries will gravitate toward the USSR if it wins the nuclear power race, regardless of the aversion they have for tyranny, it will be quite clear that this power race is no Everest-climbing, kudos-providing contest.

"Until recently defense demands have limited large scale nuclear power efforts primarily to military propulsion projects, such as submarine reactors. But the world situation, as well as the evolving progress of reactor technology, now call for a great change of pace. With this in mind the Commission has decided that it is time for full-scale construction.

"There has been much talk and perhaps guarded criticism among some scientists and some industrial groups of the choice of the particular reactor design that we have selected for our first large-scale reactor. I might hazard a guess that part of this attitude was generated by the fact that the design chosen was inherited from a Naval project. Be that as it may, let me assure you that it was not selected at random but is one of several studied for some time and approved by the entire reactor fraternity—and in addition, that this particular reactor was much farther along than any of the alternate systems.

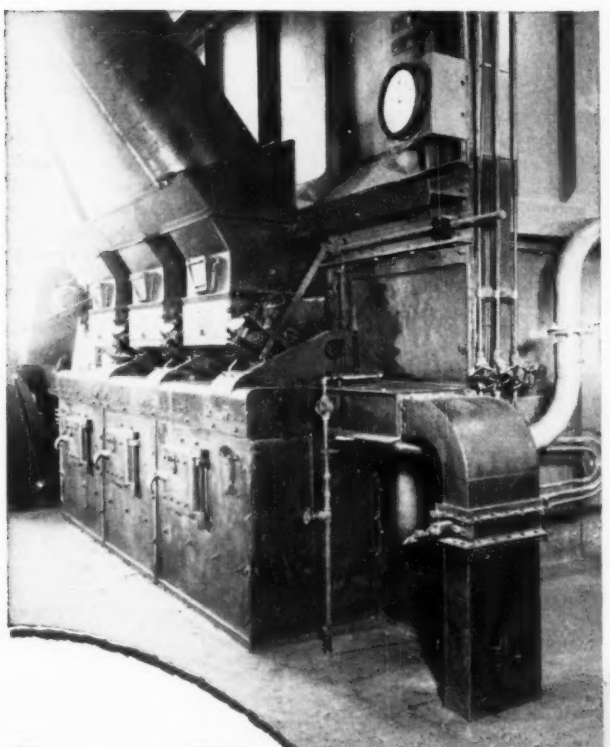
"Because of Westinghouse's previous experience with the reactor system chosen, they have been picked by the Commission as principal contractor for the development of this first power reactor. Private enterprise and private capital are invited to participate. The Commission will welcome offers from industry to invest risk capital in the building of the steam and turbine portions, as well as in the operation of the entire plant."

Institute of Power Engineers Hears Broad Technical Program

BIGGER AND BETTER than even before tells the story of the annual convention of the Institute of Power Engineers and Canada's four-day Power Show, Oct 19 to 22, in the Royal York Hotel of Toronto. Main activities included seven tech-

24 hours a day 7 days a week

Detroit RotoGrate Stoker in Ladish Malting Co.



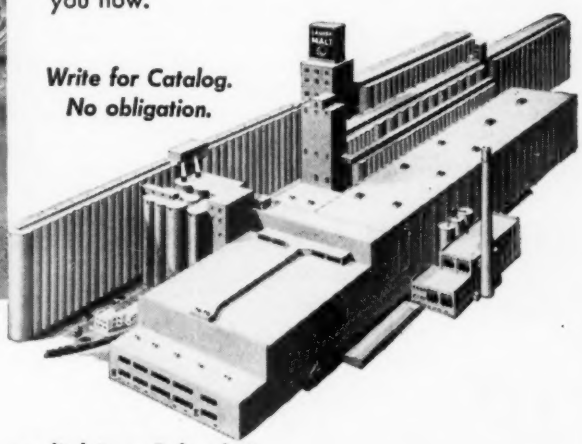
Exceptional reliability and very high availability are an utmost necessity in malting plant operation.

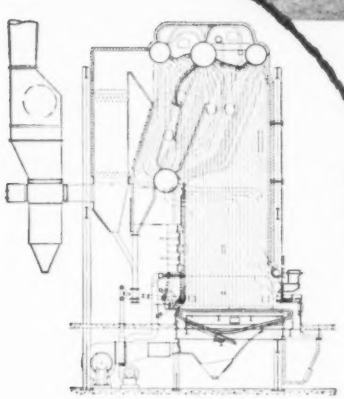
Enormous quantities of steam are needed in the Jefferson Junction, Wisconsin, plant of the Ladish Malting Co. for power and process. Ten million bushels of malt are manufactured annually. Steam generating equipment operates 24 hours a day and 7 days a week.

Difficult firing problems are always best solved by the use of Detroit RotoGrate Stokers.

Why not let them start saving money for you now.

Write for Catalog. No obligation.





Detroit RotoGrate Stoker applied to a Babcock & Wilcox—4 drum Stirling Boiler with Superheater and Economizer Capacity 75,000 pounds. 410 psi 600° F.

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

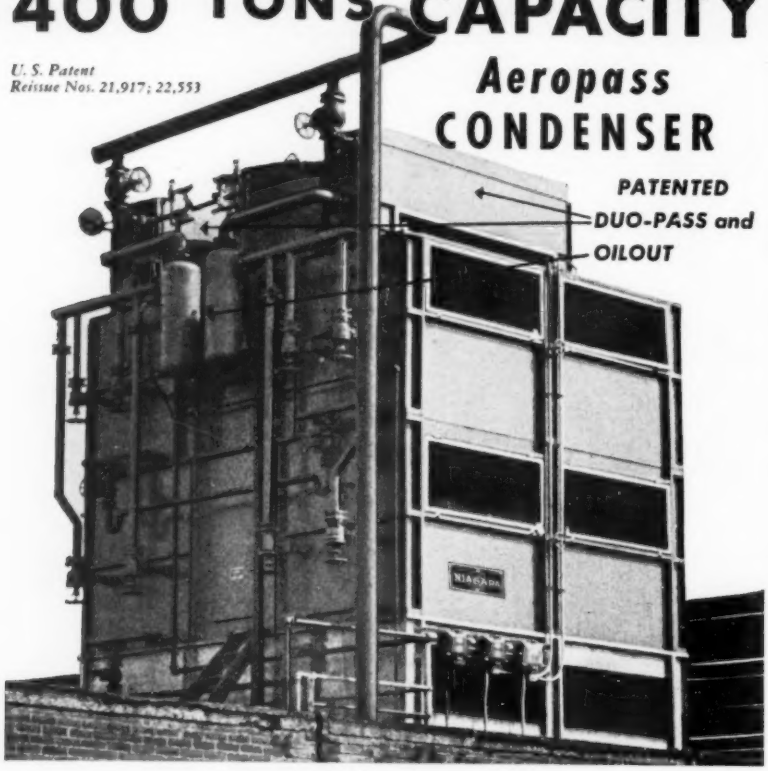
WORKS IN MONROE, MICH.

400 TONS CAPACITY

U. S. Patent Reissue Nos. 21,917; 22,553

Aeropass CONDENSER

PATENTED DUO-PASS and OILOUT



YOU USE LESS POWER...

SAVE CONDENSER WATER...

SAVE UPKEEP COST

For large refrigeration systems, NIAGARA gives you a choice between a battery of condensers (that may be cut on or off with the load) or a high capacity condenser that saves space.

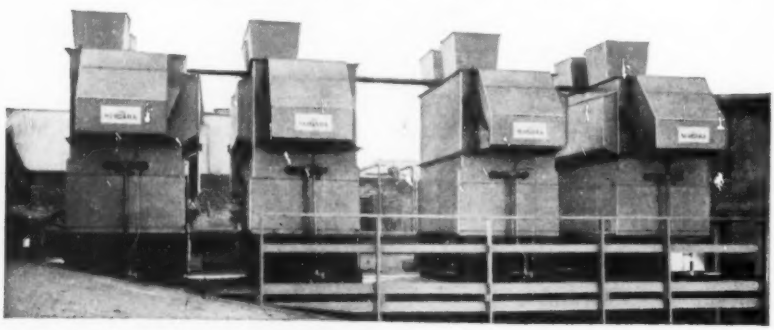
Both have the patented "Duo-Pass" and "Oilout" that remove superheat and keep the system free of oil. Results: you save one-third or more of power cost and upkeep expense. Niagara Patented Balanced Wet Bulb Control gives lowest head pressure operation automatically. ***Write for Bulletin 111.***

NIAGARA BLOWER COMPANY

Over 35 Years' Service in Industrial Air Engineering

Dept. P, 405 Lexington Ave. New York 17, N. Y.

Field Engineers in Principal Cities of U. S. and Canada



More POWER NEWS

Begins on page 152

nical sessions, three luncheon meetings and two banquets.

Delegates from 29 Institute branches covering the full breadth of the Commonwealth brought total convention registration to 2500. By Sept 30, a 38.3% jump in membership had insured more than 1000 new members for this year and brought total registration to 3500.

Dr David A Keys, Chairman, Project Coordinating Committee of Atomic Energy of Canada, officially opened the convention and power show with an address, *Industrial Applications of Atomic Energy*. He stated that Canada's atomic scientists are abreast of developments in both the United States and Great Britain, that her experts are sticking to their predictions that it will be ten years before useful electric power can be developed from atomic reactors. Atomic power plants are feasible on a commercial basis, Keys said, but considerable research will be needed at the pilot plant level before industry can use them.

Papers presented at the technical sessions included: *Turbulent Suspension Burning of Waste Fuels* by Otto de Lorenzi of Combustion Engineering, *Byproduct Power* by John Aikman of Canadian Celanese Ltd, *Reducing Flue Dust Emission* by Charles H Marks of Bituminous Coal Research, *Steam Turbines* by D F Abel of Canadian General Electric Co, and *Place of Steam Power in Canada* by E R Davis, consulting engineer.

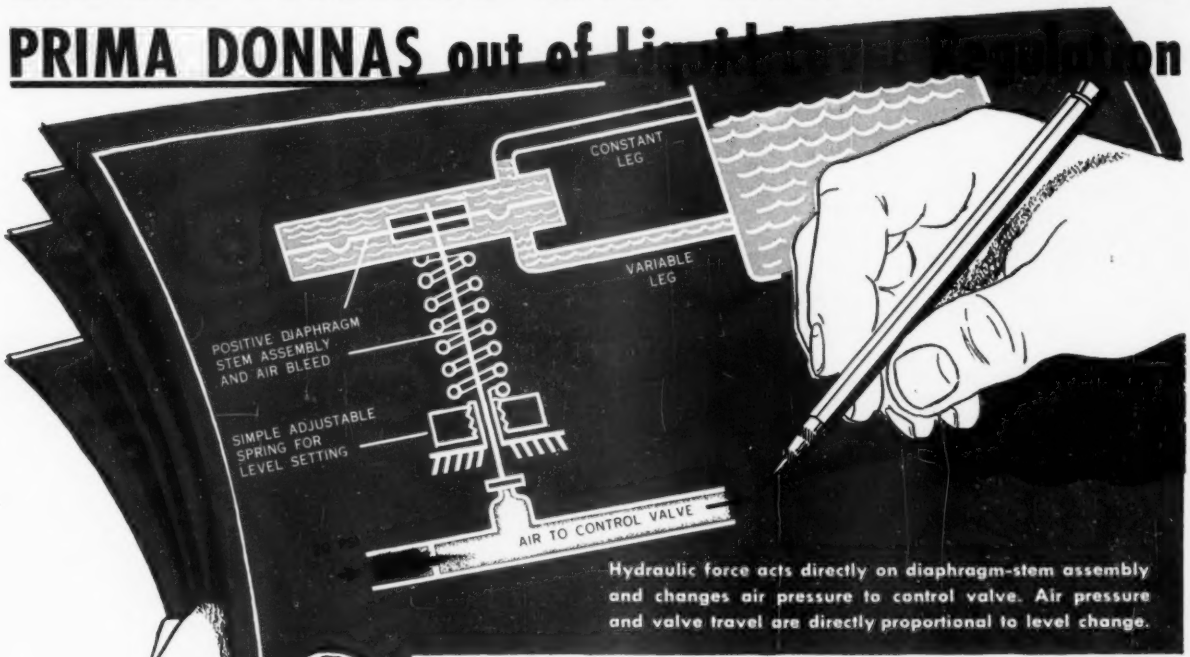
Abel reviewed the development and application of steam turbines from their earliest days down to the present and then took a look at the future. He said that the trend toward higher temperatures and pressures will continue and will extend itself right down to mechanical-drive turbines. Today the metallurgist holds the key to this progress, Abel said, since it is practically impossible for the design engineer to improve performance until he's given improved materials with which to work.

The steam turbine now holds the spotlight in the power field, and everyone is wondering what will be revealed next. During the last five years, pressures have risen from 1800 to 4500 psi, temperatures from 1000 to 1150 F. Single-shaft, 3600-rpm units will soon generate 200,000 kw as compared with the 100,000-kw units of five years ago. There appears to be no limit. The steam turbine industry anticipates that it eventually will build units capable of delivering half a million kw.

ASME Honors Dr Adolph Meyer

THE GAS TURBINE POWER division of the American Society of Mechanical En-

LESLIE *Floatless* Level Control takes the PRIMA DONNAS out of Liquid Level Regulation


CONSTANT LEG
VARIABLE LEG
POSITIVE DIAPHRAGM STEM ASSEMBLY AND AIR BLEED
SIMPLE ADJUSTABLE SPRING FOR LEVEL SETTING
AIR TO CONTROL VALVE

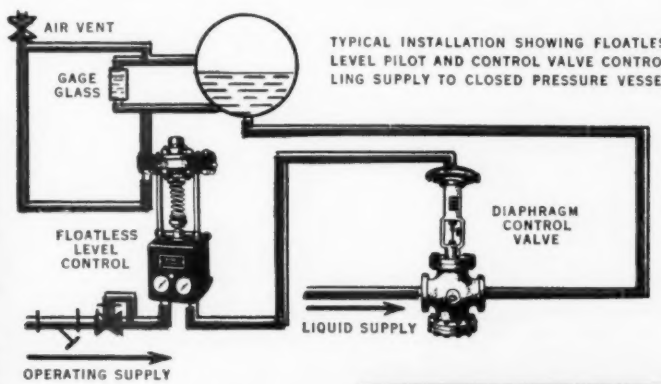
Hydraulic force acts directly on diaphragm-stem assembly and changes air pressure to control valve. Air pressure and valve travel are directly proportional to level change.

Here is level control that is not affected by surface agitation, equipment vibration, or the roll of a ship—a simple design that provides steady, positive, precise control even under extreme conditions.

Thousands are in service today, providing accurate control of liquid level (plus or minus 1″ water column) and eliminating the problems caused by troublesome linkages, torque tubes, floats and stuffing boxes.

Note these special features—

1. **Can be installed anywhere below liquid level . . . on control panel, if desired.**
2. **Simple, compact, one adjustment unit . . . weighs only 40 lbs.**
3. **Diaphragm stem assembly is only moving part. Diaphragm element doesn't require recalibration during service.**



TYPICAL INSTALLATION SHOWING FLOATLESS LEVEL PILOT AND CONTROL VALVE CONTROLLING SUPPLY TO CLOSED PRESSURE VESSEL.

SEND FOR DESCRIPTIVE DATA PC-37

When specifying . . .

Here's *another* LESLIE *standard* item to fit specifications that are *special* orders with most manufacturers. When specifying pressure, temperature or level controls—for new or replacement service—it will pay to check *first* with your nearest LESLIE engineer. He's listed in the classified telephone directory in principal cities . . . under "Regulators" or "Valves"

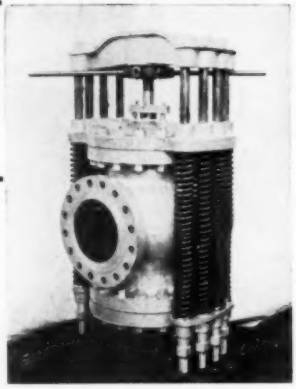
LESLIE

TOPS IN QUALITY PRESSURE LEVEL AND TEMPERATURE CONTROLS

Since 1900

LESLIE CO., 235 Grant Avenue, Lyndhurst, New Jersey

A Valve That Will Interest Every Power Engineer



THE DAVIS No. 265 HIGH PRESSURE RELIEF VALVE

USES.—(1) For turbine relief on bleeder system. (2) For protection of any boiler room or process equipment by relief to atmosphere. (3) For relief of high pressure lines to low pressure lines at predetermined pressure. (4) For use in plants carrying multiple boiler pressures to protect lower pressure systems.

ADVANTAGES.—Multiple springs for less spring accumulation . . . less build-up for maximum relief . . . less blowdown to close. Compact design with springs at sides reduces headroom requirements. Center adjusting screw for easy change of pressure setting.

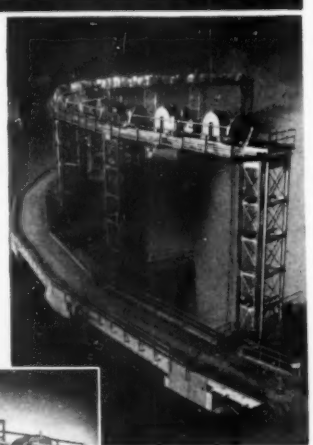
BUILT TO REQUIREMENTS.—Offered in sizes from 4" to 30" in semi-steel or steel, bronze or stainless trim. Test lever and hold-open device available. Information on request.

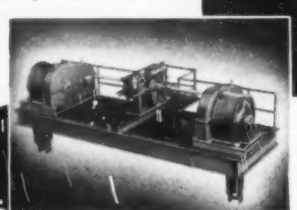
Davis
DAVIS REGULATOR COMPANY

2540 S. WASHTENAW AVE. **CHICAGO 8, ILL.**

MURCO GATES...GATE HOISTS for any Size Power Dam...

Murray Gate Hoists are designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist. In over 50 years of designing and building gate hoists, we have developed designs for many gate hoist problems. We may have designs and patterns to fit your special requirements. In planning gates or gate hoists, we suggest you write us before your over-all plains are complete . . . it may save time and money. We also build gate hoists to fit your plans and specifications.





8 MURCO Spillway Gate Hoists, 125 ton capacity, installed by the Washington Water Power Co., Cabinet Gorge Project, Clark Fork River, Idaho.

DESIGNED and BUILT TO MEET ALL REQUIREMENTS

Write for complete information and Engineering Department recommendations.

Write

D. J. MURRAY MANUFACTURING CO.
WAUSAU MANUFACTURERS SINCE 1883 WISCONSIN

More POWER NEWS

Begins on page 152

gineers honored Dr Adolph Meyer Oct 16th with a testimonial dinner at the Engineers Club of New York. L N Rowley, Chairman of the division's Awards Committee, presented Dr Meyer with a certificate that read in part: ". . . for his pioneering work in the field of gas turbines including the first central station gas turbine and the first gas turbine locomotive placed in operation in the world."

This is one of two awards that Dr Meyer has received during his current visit to this country. The other, the George R Henderson Medal, was presented to him by Franklin Institute of Pennsylvania (Oct POWER, p 170).

Coming Events

Jan 18-22—American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York City. For details write AIEE, 33 W 39th St, New York 18, N. Y.

Mar 15-19—National Association of Corrosion Engineers, Tenth Annual Conference and Exhibit, Kansas City, Mo. For details write A B Campbell, exec secy, NACE, 1061 M & M Bldg, Houston 2, Texas.

Mar 23-26—National Association of Power Engineers, 52nd annual power show, Sherman Hotel, Chicago, Ill. For details write A F Thompson, Suite 1050, 176 W Adams St, Chicago 3, Ill.

May 16-20—National Indoor Comfort Exposition, Commercial Museum, Philadelphia, Pa. For details write R H L Becker, Oil-Heat Institute of America, Inc, 500 Fifth Ave, New York 36, N. Y.

NBS Lab Measures Soil Corrosion

A RECENT STUDY by the National Bureau of Standards shows that reliable data on corrosion of ferrous metals in soils of various types can be obtained in the laboratory in a period of six months whereas usual field tests for this purpose last ten years or more. In the NBS investigation, corrosion was produced in small lab cells by differential aeration of metal disks in contact with soil within the cells. The results for 15 different soils showed good correlation with corrosion observed on wrought specimens in long-term tests. This new technique thus provides a valuable basis for predicting service of iron and steel structures exposed to various soils.

Corrosion of metals in many soils results chiefly from differences in accessibility of oxygen to the surface. Different oxygen concentrations create different potentials for various areas and result in flow of electric currents through the soil from anodic oxygen-deficient areas to cathodic areas of rela-

Check List

for selecting a Piping Contractor

Listed below are a number of important factors that should be taken into account whenever you select a piping contractor. If any of these are overlooked, you are not buying your piping construction to best advantage.

EXTENSIVE SIMILAR EXPERIENCE • Is the contractor thoroughly experienced on your type of work? Problems are always more readily solved when they have been met before.

MODERN FABRICATING PLANTS • Fully equipped plants staffed by piping experts mean practical piping subassemblies that are correctly planned and prefabricated to simplify and expedite field erection.

PROGRESSIVE ORGANIZATION • You want a contractor who keeps abreast of new piping developments. Piping research on a continuous basis should be his policy.

CONVENIENT LOCATION • A fabricating plant near enough to give you quick service is of prime importance. Convenient location also improves overall supervision of the job

SUPERIOR FIELD FACILITIES • A job of any size needs a resident superintendent with a permanent staff of supervising erectors. Welders should be qualified on your materials.

PLUS SERVICES • The experienced contractor often can make suggestions that result in improved piping design and savings in time and money.

4586

You can check all these when you select MIDWEST

MIDWEST PIPING SERVICE IS NATION-WIDE

4 Plants Are Better Than 1

PIPING FABRICATORS AND CONTRACTORS

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
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Sales Offices: New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.

Efficiently removing the *sting* from industrial smoke requires considerable skill and experience. Buell has spent the past twenty years acquiring both!

Because dust content varies, Buell specialists first analyze the dust, then make a detailed study of on-the-job conditions. It is because of this sound approach that Buell has been so unusually successful.

Users of Buell equipment, many of them leaders in their own fields, have reported that the collection of dust has greatly improved employee morale, increased production and made really significant contributions to plant-community relations. We will be glad to supply the names of present Buell users right in your own field.

Our informative brochure—The Collection and Recovery of Industrial Dusts—explains all *three* Buell systems for industrial dust collection. For your complimentary copy write Dept. **50-L,** Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

buell®

MECHANICAL ELECTRICAL *20 Years of Engineered Efficiency*
DUST COLLECTION SYSTEMS

More POWER NEWS

Begins on page 152

tive abundance. Corrosion cells used in NBS labs made use of this principle.

These cells could detect significant differences between corrosion rates of cast iron and steel, rates usually considered to be equivalent. Thus, the cell might be used to study effects of variables such as composition upon corrosion rates. The cell might also predict corrosion rates for nonferrous metals. Although laboratory tests will not replace field tests, results are sufficiently well related to be of use in selecting materials for field tests.

MAPPA Plans $25,000 Air Pollution Study

DR H A LEEDY, director of Armour Research Foundation and president of Midwestern Air Pollution Prevention Assn, recently announced plans for a $25,000 study to combat air pollution in the Chicago area.

Addressing the association's fall meeting in Gary, Ind., Leedy detailed MAPPA's 3-point program as follows:

1. A study to determine sources of pollution.
2. Study and analysis of a large number of case histories of smoke violations in the files of the city's Air Pollution Control department.
3. An education program to inform Chicago residents of the problem and how it can be controlled.

APPOINTMENTS

Corporation Executive Changes

Stone & Webster Engrg Corp: T Cortland Williams, from vice-president and senior construction manager to executive vice-president. **United Engrg Trustees, Inc:** James L Head, president, succeeding R F Gagg; Gail F Moulton and Walter J Barrett, vice-presidents. **American Blower Corp:** J C Lindenmeyer, from vice-president of manufacturing to president.

Tensolite Insulated Wire Co, Inc: J J Dowling, vice-president. **Flexible Steel Lacing Co:** Milton B Beach, president; John P Ramsey, vice-president and sales manager. **Clapp & Poliak, Inc:** Kenneth E Knowles vice-president. **American Engrg Co:** E M Beazel, manager of the Chicago office succeeding Paul N Dotzenroth, now president of Baker Valve Co.

Operations Executive Changes

Servel, Inc: Theodore W Rundell, vice-president in charge of operations. **Borg-Warner Corp:** Harry P Troandly, presi-

THESE EXCLUSIVE PRECISION-MACHINED GUIDES

eliminate chatter

lengthen service life

IN LUNKENHEIMER

IRON BODY GATE VALVES

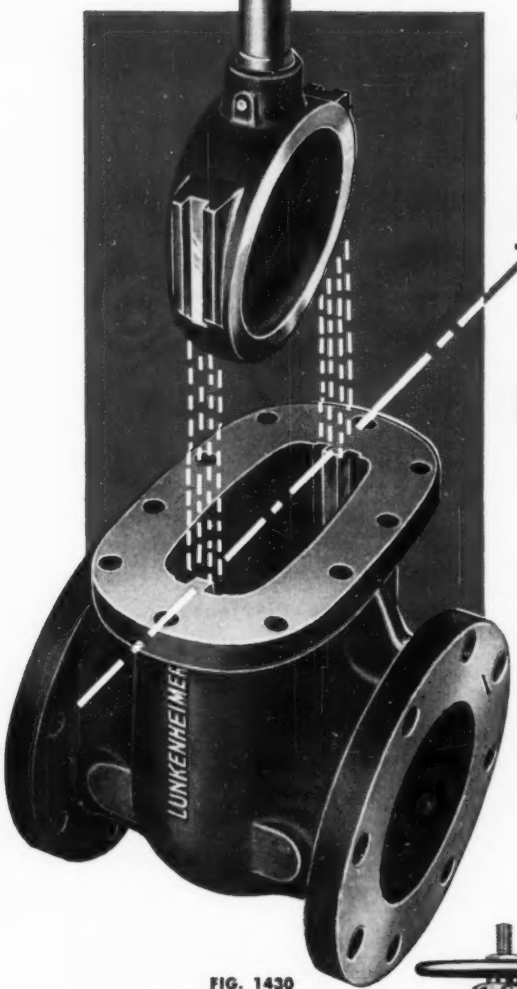
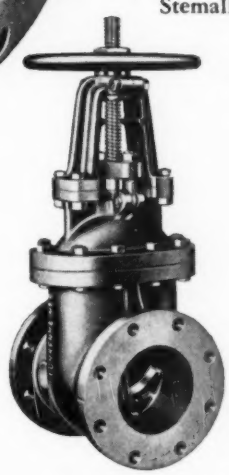


FIG. 1430

Iron Body Bronze Mounted
Also Available in
FIG. 1576 and 1578
All Iron
Screwed and Flanged Types

This exclusive machined-guide design is only one of the many original money-saving features of Lunkenheimer Iron Body Gate Valves. Gate valve chatter — the sound of wasteful, accelerated wear—is eliminated by Lunkenheimer's unique method of manufacture. Not only are the guide channels in the disc accurately machined, but the guides in the body, as well. These precision-machined guides hold the disc firmly in line as the valve is opened and closed — prevent pressure from forcing the disc against the opposite seat. Result: no clatter, no chatter, and much longer valve life. When repair is necessary, replacement parts can be easily installed without machining or fitting — an exclusive Lunkenheimer feature. In addition, Lunkenheimer Iron Body Gate Valves have long-wearing Stemalloy® Stems, bronze bushings that protect the stem from corrosion and scoring, and handy swing bolts and shelves that make repacking so easy. No other iron-body valve gives you so much *outstanding* value.



WRITE FOR Circular 564, describing the complete Lunkenheimer Iron Body Gate Valve line. Address: The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio, or phone your Lunkenheimer Distributor.

LUNKENHEIMER
L
QUALITY

IRON • STEEL • BRONZE

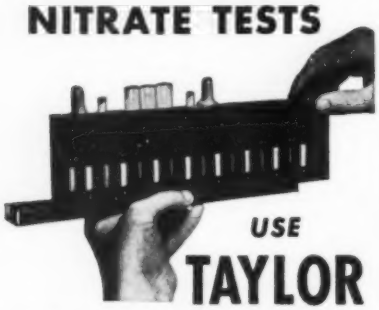
LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-253-9A

How to make

ACCURATE BOILER WATER pH, PHOSPHATE, NITRATE TESTS

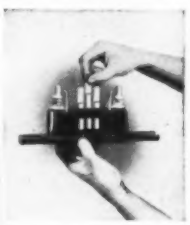


USE TAYLOR COMPARATORS

You can make many determinations in seconds . . . longest take only two minutes. Taylor Sets are lightweight, easy to carry for on-the-spot tests, or you can use them in the lab. Each set complete with accessories and reagents.

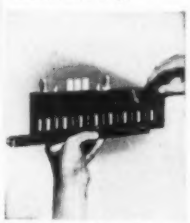
Easy as A • B • C

A. Fill three test tubes with sample to be tested and place them in the base.



B. Add reagent to middle tube only.

C. Place color slide on base, move across until colors match, and . . . THERE'S THE VALUE!



Guaranteed Color Standards!

Sealed-in-plastic color standards carry an unconditional guarantee against fading that gives you complete freedom from mechanical inaccuracy in making determinations. No single standards to handle. Each slide contains a complete set of standards for any one determination.

SEE YOUR DEALER . . . for equipment. Write direct for FREE HANDBOOK on pH and Chlorine control in 34 basic industries. Also illustrates and describes all Taylor Sets.

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.

More APPOINTMENTS

Begins on page 264

dent of the Spring Division, succeeding David E Gamble, retired. **E F Drew & Co, Inc:** M E Reiner, manager of Power Chemicals Division. **Electric Storage Battery Co:** Roland Whitehurst, general manager of industrial products division. **Pabco Products, Inc:** James W Cordrey, Eastern Regional Manager for Insulation Dept.

New Sales Managers

General Electric Co: O B Falls, Jr, Electric Utility Sales of Apparatus Division; Albert L Baldock, new Eastern District; Constantine L Chase, new Midwest District. **Trane Co:** John G Hamm, St Louis office. **H K Porter Co, Inc:** G N Dow, Chicago District of Leschen Wire Rope Division. **General American Transportation Corp:** Ben King Duffy, southern California office of Plate and Welding Division. **American Brake Shoe Co:** John S Carr, pump sales for American Manganese Steel Division. **Leebaw Mfg Co:** James Schwarz, general sales manager. **Flexonics Corp:** Thomas K Wells, general sales manager. **Cooper-Bessemer Corp:** R G Williamson, Los Angeles district office. **Greer Hydraulics, Inc:** William J Cunningham, asst sales manager for industrial hydraulic accumulators and components.

New Sales Engineers

Westinghouse Electric Corp: Robert H Wagner, general application engineer of Elevator Division. **Edward Valves, Inc:** H W Bierman, territory comprising Oklahoma and parts of Missouri, Kansas, Arkansas and Texas. **Borg-Warner Corp:** Harry J Scott, automotive hydraulic steering applications for Pesco Products Division. **Livingstone Engrg Co:** L E Petzinger, field engineer for northern Ohio. **Reliance Electric and Engrg Co:** James D Weber, application engineer for Detroit district office.

Tube Turns, Inc: Bert Grant, Pittsburgh office; Clyde Chronister, Tulsa office; Richard T Burke, Houston staff; Earl R Muir Jr, Seattle office. **William Powell Co:** Donald A Elert, northern Michigan, Wisconsin and Minnesota territory; Kemp Pierce and Tom Williams, Houston office. **Pacific Transformers, Inc:** William Herron, West Coast area. **Pierce Governor Co, Inc:** Roy W Green, special assignment field man.

New Distributors

Graybar Electric Co, Inc: Abilene, Texas branch under E L Preston, manager and H L Coldwell, operating manager; Springfield, Illinois branch under Harry Bryson, manager, and C W Kraich, operating manager. **Barber-Colman Co:** factory branch office for Automatic Control and Uni-Flo Divisions at Indianapolis under Don Horack and at Omaha under Tom Peterson. **Reliance Electric & Engrg Co:** direct factory sales office in San Francisco. **Boston Woven Hose & Rubber Co:** new warehouse in Dallas.

This message from

Power

appeared recently
in Business Week
to remind management men
throughout iudustry
of the vast scope
and key importance of
power
and of the men
who direct
the power services

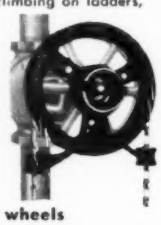
→

Protect YOUR MANPOWER with...

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

Control out-of-reach overhead valves right from the floor! No more climbing on ladders, balancing on boilers, perching on workbenches or machines. Prevent accidents and costly claims — also save fuel, steam and money.

Only four simple, quickly-assembled parts installed and operating in only a few minutes, Babbitt Adjustable Sprocket Rim with Chain Guide —



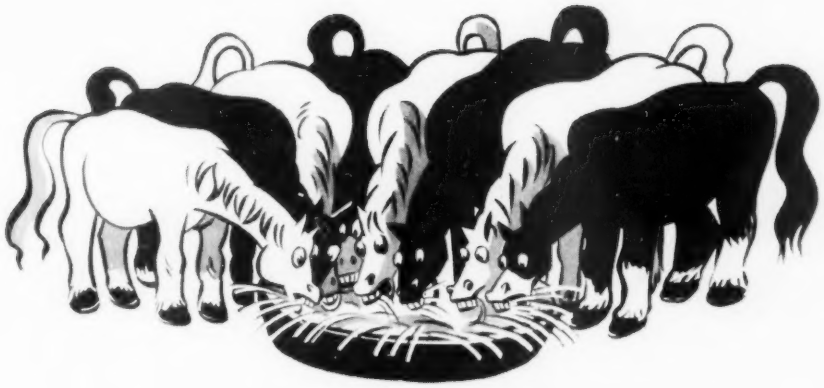
- **Fits all valve wheels**
- **Simplifies pipe layouts**
- **Eliminates risky climbing**

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO

2 BABBITT SQUARE, NEW BEDFORD, MASS.



How much does it cost to feed 8 horses?

Most management men really ought to know the answer to that question. Because every worker in the U. S. has an average of eight horses of power behind him.

And don't think you're not paying for those horses!

Raw power, of course, is one of the cheapest of all our raw materials. (Thanks to our vast utilities, electric power for example has dropped 21% in cost in 15 years.) But that doesn't mean your own power system is operating as cheaply as you can make it.

You might be wasting kilowatts, and horsepower, right and left and through the roof. Fact is, through-the-roof is one of management's favorite ways of wasting power.

How much steam does your plant vent to the free and open air?

There's at least one man in your organization who knows exactly what those eight horses cost. He's the fellow with responsibility for furnishing the things your plant needs to function. Electricity, heat, water, compressed air, maybe refrigeration and maybe air conditioning.

Have you turned him down on any new equipment lately? Do you know such change has taken place in recent years in almost all kinds of power equipment that you can often quickly earn back the purchase cost with operating savings?

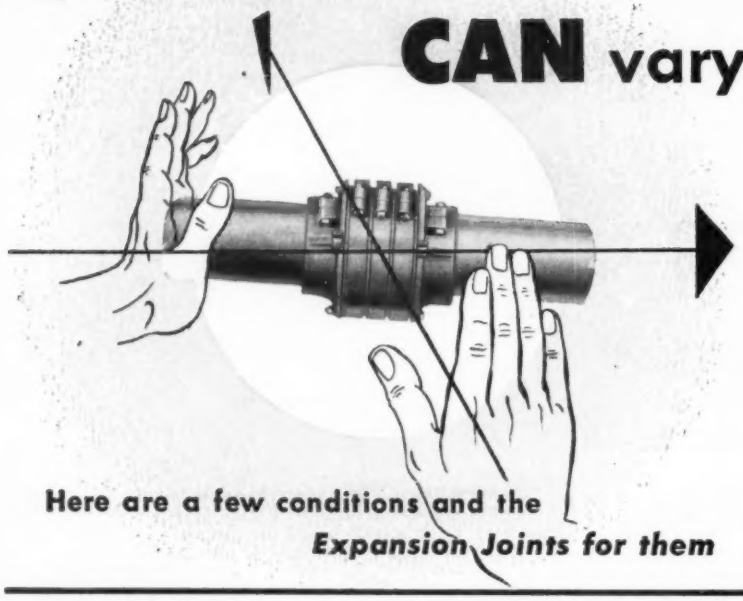
Your power-system engineers know. They may have learned a lot of it from the pages of POWER magazine. This magazine's job is to keep them informed on new ideas, new methods, new products.

So, if you haven't lately looked at your power system, and talked to its bosses, do so. You might find your oat bill is way too high.

One of America's primary industrial media and a member of the Audit Bureau of Circulations

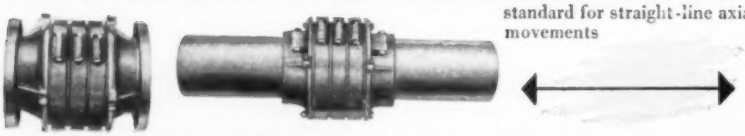
McGRAW-HILL . . . ABP

Pipe line movements **CAN** vary



Here are a few conditions and the *Expansion Joints for them*

BADGER DIRECTED-FLEXING SELF-EQUALIZING JOINTS



standard for straight-line axial movements

BADGER TANDEM JOINTS

for lateral or combined lateral-axial movements: designed individually for each problem

BADGER NON-EQUALIZING JOINTS

ideal for use between turbine and condenser and for many other applications which require a flexible connection to absorb a slight amount of expansion misalignment or vibration

BADGER HINGED TYPE JOINTS

Hinged type expansion joints are designed to absorb expansion in one plane by angular rotation. They must be used in pairs and are specially designed to meet individual applications. Available in both non-equalizing and self-equalizing types, either flanged or welded ends.

The above designs suggest the versatility of the Badger corrugated type of expansion joint . . . *the joint that requires no maintenance.* There are others equally useful. If you have *any* kind of problem like those outlined above or any other pipe line movement you must control and absorb, write us in detail. We shall be glad to submit recommendations.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.

More APPOINTMENTS

Begins on page 264

New Representatives

For **Heat-X-Changer Co, Inc:** General Hydraulics Co, of Newark, N. J.; H C Halbert of Atlanta, Ga. For **National Radiator Co:** Gerald R Cox, northern California and Nevada territory. For **Black, Sivalls & Bryson, Inc:** Peter A Puleo, St Louis district. For **Precision Transformer Corp:** Edward T Mug, Colorado, New Mexico, Wyoming territory; C W Bates, Michigan area. For **Livingstone Engrg Co:** Midwest General Corp of Detroit, Michigan territory. For **Polymer Corp of Penna:** B C MacDonald & Co of St Louis.

Recent Purchases, Mergers

West Penn Power Co: transmission and distribution system of Natrona Light & Power Co. **Eclipse Fuel Engrg Co:** Solenoid Valve Division of Wheaton Engrg Co. **Marlow Pumps:** a merger, as of Dec 1st, with Bell & Gossett Co. **Billings & Spencer Co:** purchase of majority of common stock of Peck, Stow & Wilcox Co. **Elgin Softener Corp:** a merger with Refinite Sales Co of Omaha, Neb.

New Addresses

W H Brady Co: 727 W Glendale Ave, Milwaukee 12, Wisconsin. **Dravo Corp:** Heating Dept of Machinery Division now located in Chamber of Commerce Bldg, 411 Seventh Ave, Pittsburgh 19, Pa. **Sumco Engrg Co:** offices, laboratory and plant now at Caldwell, N. J., PO Box 193. **Sterling Electric Motors:** Cincinnati office now at 2904 Woodburn Ave, Cincinnati 6, Ohio.

Institute Elections, Awards

Atomic Industrial Forum, Inc: Charles E Robbins, executive manager. **Air-Conditioning and Refrigeration Institute:** George K Iwashita, chairman of Water Cooler Section. **Ralph E Flanders:** the 1953 Howard Coonley Gold Medal for "service in advancing the national ecenomy through voluntary standards." **Dr Mervin J Kelly:** Industrial Research Institute Medal for 1954.

Obituaries

Clark T Morse, 64, president of American Blower Corp, Sept 18th.

John O Larson, 39, director and executive vice-president of Fischer & Porter Co, Sept 18th.

David Fettes, 88, well-known architect and builder, Oct 8th.

Herbert D Tietz, 55, manager of sales of Inco Nickel Alloys Dept of International Nickel Co, Oct 11th.

W Earle Shumway, manager of sales engineering for Norton Co, Oct 25th.

LOW COST

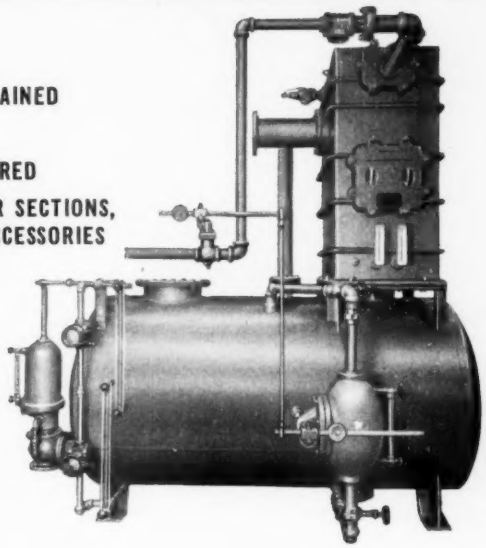
High Efficiency Deaeration

FOR SMALL AND MEDIUM SIZE POWER PLANTS

COCHRANE

UNI-PAC DEAERATOR

- FACTORY ASSEMBLED
- COMPLETELY SELF-CONTAINED
- EASY TO INSTALL
- MINIMUM PIPING REQUIRED
- WIDE RANGE OF HEATER SECTIONS, STORAGE TANKS AND ACCESSORIES TO MEET ANY PLANT REQUIREMENT
- GUARANTEED ZERO OXYGEN



Here's the deaerator every small and medium-size plant has been waiting for!

Now for the first time you can get a ready-to-install deaerator that will give you high quality boiler feedwater at extremely low cost. The UNI-PAC DEAERATOR is guaranteed to deliver water with an oxygen content not to exceed 0.005 c.c. per litre (less than 7 p.p. billion)—generally recognized as zero oxygen!

The UNI-PAC DEAERATOR is designed for both right and left hand installation, and in a wide range of outlet and storage capacities. Accessory equipment is available to meet operating conditions peculiar to the plant and to obtain the results desired.

Publication 4643 contains complete details. Write today for your copy.

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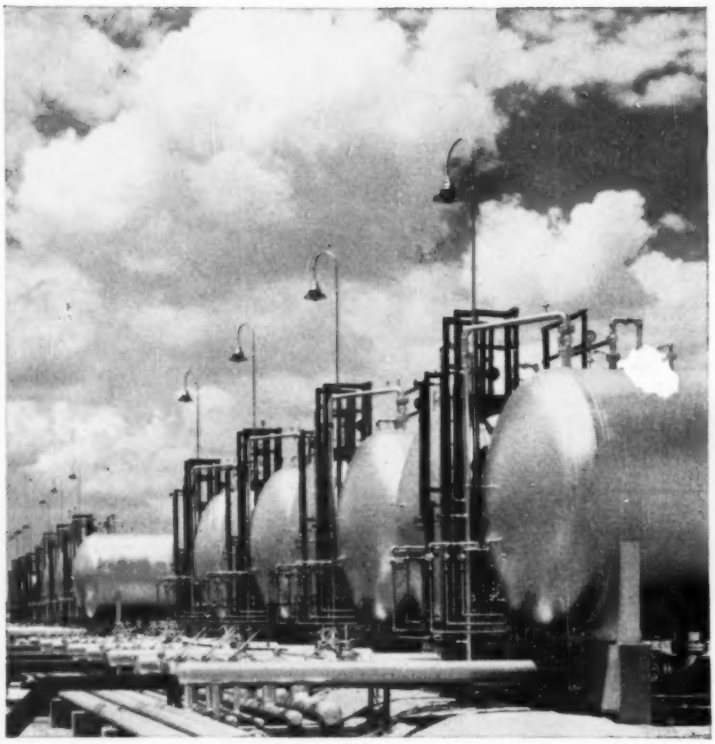
Representatives in principal cities in U.S.A. In Canada, Mexico, Paris, Cuba, Venezuela, Puerto Rico, Hawaii.

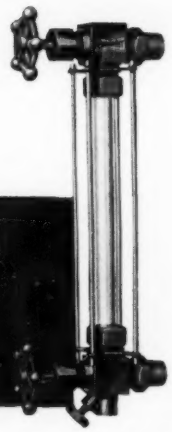
Hot Process Softeners • Deaerators • Dealkalizers • Demineralizers • Reactors • Continuous Blow-Off • Specialties • C-B Systems

For any pressure... in any length

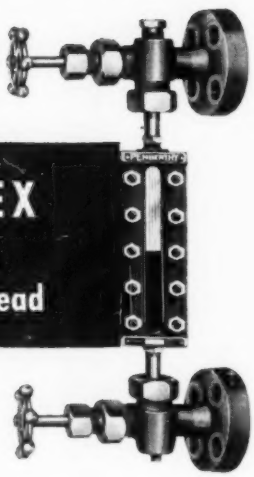
SPECIFY PENBERTHY

LIQUID LEVEL GAGE SETS

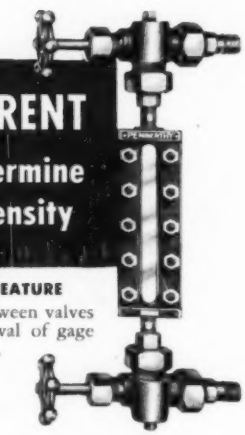




TUBULAR
Meets Navy specifications



REFLEX
Accurate, easy-to-read



TRANSPARENT
Quickly determine color and density

DON'T MISS THIS FEATURE
Union connections between valves and gage permit removal of gage without shutting down.

Corrosion-resisting Penberthy gages and valves indicate accurately the level in vessels containing any kind of liquid. Construction is exceptionally sturdy. Materials conform to or exceed requirements of A.I.S.I., A.S.T.M. and/or A.P.I.-A.S.M.E. for maximum recommended pressures and temperatures. They are made from carbon steels, high grade bronze and malleable iron. Also available are chrome-moly and stainless steels and Monel metal. When specified, materials such as acid bronze, Everdur, nickel and Hastelloy are supplied.

For your special requirements, experienced engineering counsel and service are available to design and make valves and gages to meet your unusual conditions.

● For most requirements, Catalog 35 is a handy help in selecting and ordering. A copy will be sent upon request.

Established 1886

PENBERTHY INJECTOR COMPANY

Division of the Buffalo-Eclipse Corporation

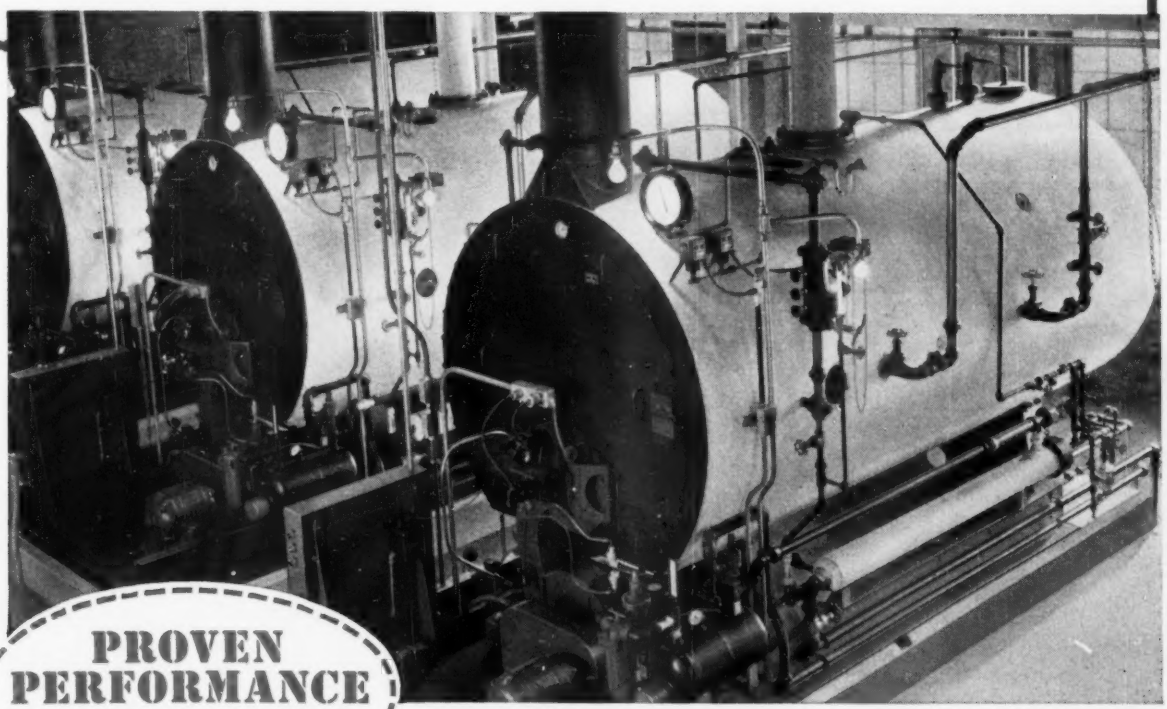
1262 Holden Avenue, Detroit 2, Michigan

There's Certain satisfaction in **PRODUCTS BY**

PENBERTHY

- CYCLING JET PUMPS
- EJECTORS
- INJECTORS
- ELECTRIC SUMP PUMPS
- EDUCTORS
- EXHAUSTERS
- SYPHONS

Cleaver-Brooks boilers save $25,000 per year for Hoosac Mills...pay for themselves in 2 years' time!



PROVEN PERFORMANCE

ANOTHER OUTSTANDING REPORT FROM A CLEAVER-BROOKS OWNER

After installation and starting service was completed, a check was made on boiler output. Tests indicated efficiency exceeded the guaranteed 80%. After eight months' operation without tube cleaning, stack temperature showed no noticeable gain, indicating high efficiency had been maintained. *Planned and installed by Frank I. Rounds Co., Newton Highland, Mass.*

INSTALLING 3 Cleaver-Brooks self-contained boilers at Hoosac Textile Mills, New Bedford Division, was a major step in ending boiler worries. Hoosac can count on yearly savings of $25,000, and they're set up for future expansion as well.

Before deciding what type of boilers to install for replacing old, hand-fired boilers, Hoosac carefully considered these factors:

1. **Efficiency of steam generation** — the cost for supplying 12,000 lbs. of steam required each hour at peak capacity for heating and processing.
2. **Saving labor costs** — through safe, automatic operation.
3. **Cleanliness** — important to textile manufacture.

A study of past performance and prominence of similar units in the industry — showed that Cleaver-Brooks self-contained boilers would fill the bill.

Guaranteed 80% thermal efficiency was one of many influencing factors in selecting the 3 Cleaver-Brooks 150 hp. boilers. Even with loads as low as 30% of rating, these boilers operate with a flat 80% efficiency. (Hoosac operates their plant over widely fluctuating loads, particularly in summer.)

That they attained their objectives is borne out by these results — *results which showed the boilers paid for themselves in 2 years' time.*

1. **$15,000 savings in fuel** — fuel cost studies showed 275,000 gals. of oil at 5½¢ per gal. provide steam for a year's operation. Same steam formerly required 2,000 long tons of coal at $15.00 per ton.
2. **$10,000 savings in labor costs** — fully automatic operation minimized boiler maintenance. Personnel were then available for productive plant work.
3. **Cleanliness** — modern boiler room proved more efficient than previous cluttered arrangement. Hand firing, removal and disposal of fly-ash was eliminated.

In addition to these substantial savings, the installation provided for economical future plant expansion. At present, boiler operation is rotated so all three periodically receive the same service and maintenance.

Cleaver-Brooks boilers are showing similar savings in many other businesses. Investigate — write for Catalog AD-100 and complete information on standard size oil, gas, combination oil/gas fired Cleaver-Brooks boilers, 15 to 500 hp., 15 to 250 psi.

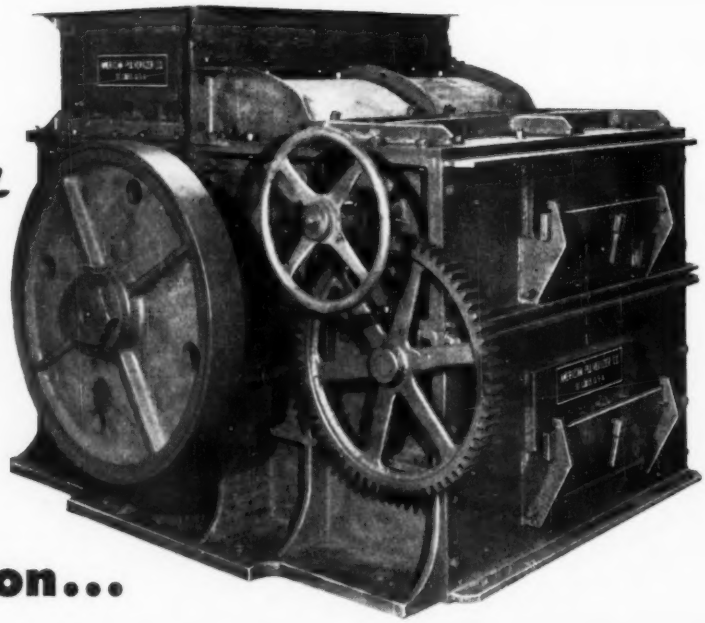
CLEAVER-BROOKS COMPANY
Dept. P, 301 E. Keefe Ave.,
Milwaukee 12, Wis., U.S.A.

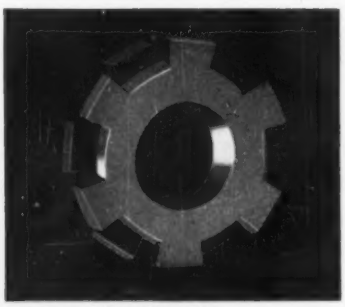
Cleaver-Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

Steam Boilers • Oil and Bitumin Tank Car Heaters • Distillation Equipment Oil and Gas Fired Conversion Burners

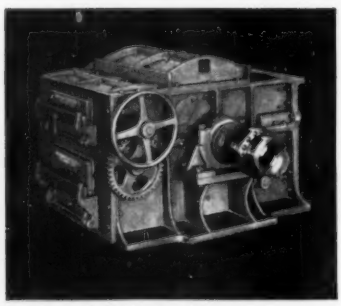
5 reasons why *American Crushers* can reduce coal for less than one cent per ton...





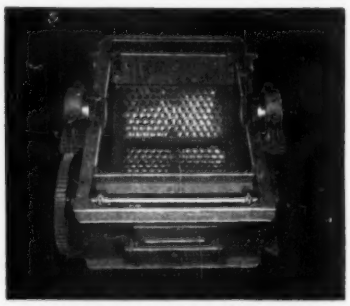
1 Patented Shredder Ring

American-originated feature that splits coal instead of smashing it—for uniform sizing, minimum fines. Result: Americans run at slow speeds, with savings in power and maintenance. No cams, shear pins, toggles.



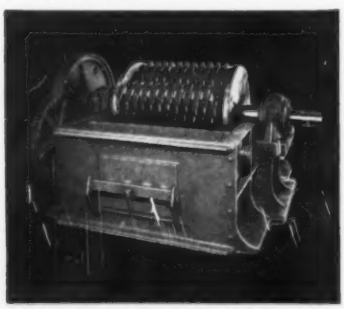
2 Heavy-Ribbed Steel Frame

Bearing pedestals are cast integrally with lower side frames. Sectional design for easy dismantling . . . abutting joints accurately machined and bolted together for dust-tight fit.



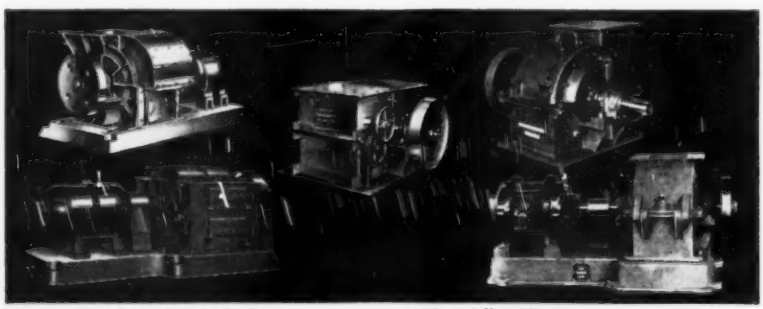
3 Completely Lined Crushing Chamber

Heavy, renewable liners . . . sectional for easy plate-at-a-time replacement . . . engineered to offer life-time protection to the frame.



4 Complete Accessibility to Adjustment and Parts

All adjustments external—even with crusher in motion. Rotor easily reached by removing top section. Rings readily reversed or replaced. Liners quickly reached, too, for periodical inspection.



5 Custom-Built to Your Needs

American has developed many crusher types, each in a number of sizes. Custom-designed with the proper crushing elements, grate bars or screen plates to produce the desired product in the quantities required.

They All Add Up!

Whenever you figure cost per ton, the best answers come from American. By actual survey, American Crushers, in use an average of ten years, show a parts replacement cost of only 1/10th of 1¢ per ton of coal crushed!

American **PULVERIZER COMPANY**

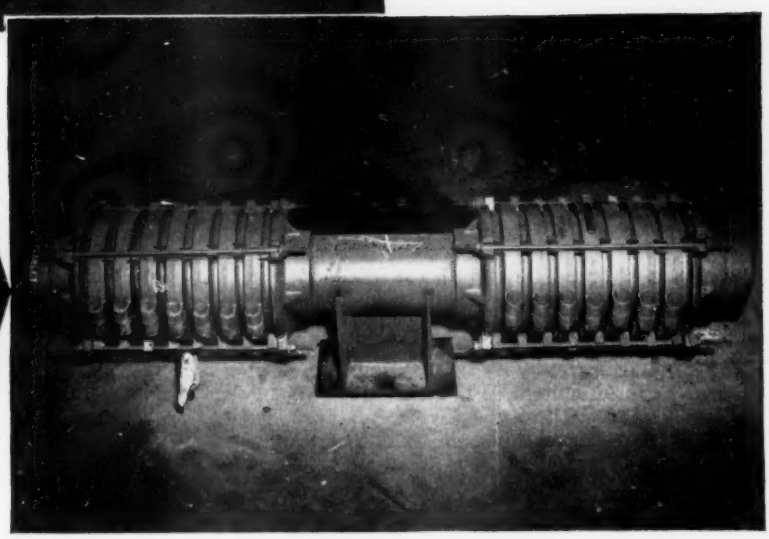
Coal Crushers up to 800 Tons Per Hour • Laboratory Crushers up to 2,000 Lbs. Per Hour

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave. • Saint Louis 10, Mo.

THIS STEAM LOSS WAS STOPPED FOR LIFE...

WHEN THIS FLEXON EXPANSION JOINT WAS INSTALLED



THREE TYPES AVAILABLE

FREE-FLEXING—*Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 30 psi, temperatures from minus 20° F. to 800° F.*

CONTROLLED-FLEXING — (Illustrated above) *Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 300 psi, temperatures from minus 20° F. to 800° F.*

FLEXONIFLEX—*Integral ring type. Available in sizes from ½" pipe through 6" pipe. Suitable for pressures to 5500 psi, temperatures from minus 400° F. to 1600° F.*

Steam loss through antiquated expansion joints in the shipyard where the upper photo was taken was calculated at over $17,500 per year before modern Flexon Expansion Joints were installed. Flexon Expansion Joints cannot leak . . . they are uni-metal assemblies which when properly installed become a part of the pipe. Unlike the joints which they replaced in this shipyard, Flexon Expansion Joints require no maintenance . . . there is no packing to take up or replace. Just install them and forget them.

If you're letting dollars escape through leaky, troublesome expansion joints, ask your Flexonics representative to show you how Flexon Expansion Joints can put an end to this problem, or write for the Flexon Expansion Joint Bulletin.

Flexonics *Corporation*

EXPANSION JOINT DIVISION
1301 S. THIRD AVENUE · MAYWOOD, ILLINOIS

FORMERLY CHICAGO METAL HOSE CORPORATION
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies products of Flexonics Corporation that have served industry for over 50 years.

Flexible metal hose

Expansion joints

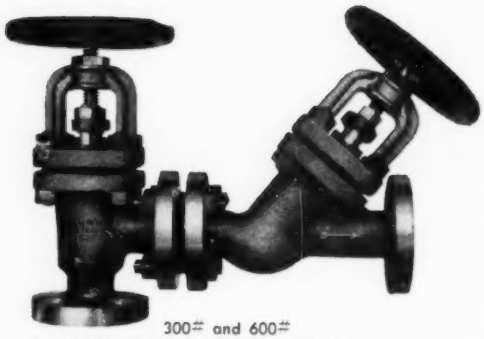
Aircraft components

Metallic bellows

Be Sure

OF DEPENDABLE, SAFE SERVICE SPECIFY

HANCOCK Blow-Off VALVES



300# and 600#

HANCOCK "BLO-DEFLECTOR" BLOW-OFF VALVES

Outside Screw and Yoke

Sizes: 1½", 2" and 2½".

Types: Straightway and Angle.

Connections: 300#—Flanged or Screwed Ends; 600#—Flanged or Socket Weld Ends.

Pressures at 800° F.: 300 psi, 416# Maximum Boiler Pressure—Flanged Ends; 515# Maximum Boiler Pressure—Screwed Ends. 600 psi, 785# Maximum Boiler Pressure—Flanged Ends; 950# Maximum Boiler Pressure—Socket Weld Ends.

Body: Cast Carbon Steel.

Seat: Integral. Has Cobalt Chromium Tungsten Alloy Facing.

Disc: 500 Brinell Stainless Steel.

Outstanding Features

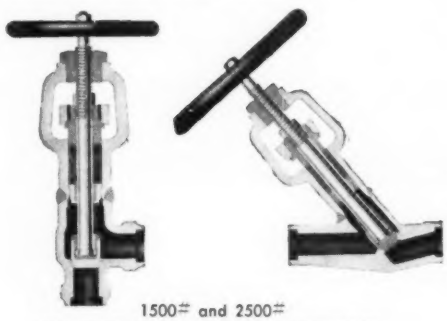
1. No body and seat joints—seat stays tight. Cost of parts and repairs reduced—seat will last the life of the valve.
2. Simple, rugged design—only 18 different parts, including nuts and bolts. "Bio-Deflector" seat and disc design makes it impossible for the velocity of the water to cut the seating surface of the disc.
3. Easy operation: No more hand power required than for ordinary stop valves. Flexible: Valve can be opened fast or slow as desired. Full hand turning power always available to close valve tightly.
4. Saves BTU's and treated boiler water through seat and disc tightness.
5. No separate so-called "quick opening" valves needed. Minimum of different parts required for tandem installation.

Hancock Blow-Off Valves provide completely reliable and safe performance in the severest services—surpass all land and marine codes and insurance provisions. They are modern valves, backed by more than 50 years of experience with the rigid operation and maintenance requirements of steam generating equipment.

Carefully selected materials of the highest quality are used to the best functional advantage to decimate wear . . . to eliminate all non-essential weight . . . to reduce overall dimensions . . . to assure easy, low-cost installation. Because they are simply designed and engineered Hancock Blow-Off Valves have a minimum number of parts—maintenance costs are negligible. Operation is smooth, efficient—you get superior performance regardless of the demands of the installation.

Whatever your boiler blow-off or water treatment practices, remember the best cost no more. Hancock Blow-Off Valves are preferred by far more design and operating engineers than any other make. So—whether you have a revalve project or are contracting for new steam generating equipment—specify Hancock Blow-Off Valves.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. Long experience in serving industry makes him fully qualified to meet your valve needs exactly and economically. Call on him for expert counsel and prompt delivery from local stocks.



1500# and 2500#

HANCOCK STEEL BLOW-OFF WELDVALVES

Outside Screw and Yoke

Sizes: 1", 1½", 2", and 2½".

Types: Straightway and Angle.

Connections: Socket Weld Ends standard. Flanged if required.

Pressures at 1050° F.: 1500 psi, 2080# Maximum Boiler Pressure. 2500 psi, 3120# Maximum Boiler Pressure.

Body: Chrome Molybdenum Steel.

Seat: Integral. Has Cobalt Chromium Tungsten Alloy Facing.

Disc: 18-8 Stainless Steel with Cobalt Chromium Tungsten Alloy Facing.

Outstanding Features

1. No bonnet or body joints to leak, no gasket to blow.
2. No seat joints—cutting of threads between body and seat eliminated. Seat can be inspected and serviced while valve is in the line, without cutting the bonnet weld.
3. Compact—diameter and height greatly reduced. Lines can be installed closer to drums, columns and structures.
4. No bulky yoke flanges—lagging and pipe hanger costs greatly reduced.
5. 50% or more reduction in weight makes handling far easier during installation.

When Hancocks go in, valve costs go down

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** Watertown 72, Massachusetts

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

How Properties of Du Pont "Teflon"* Improve Performance of Pump Components

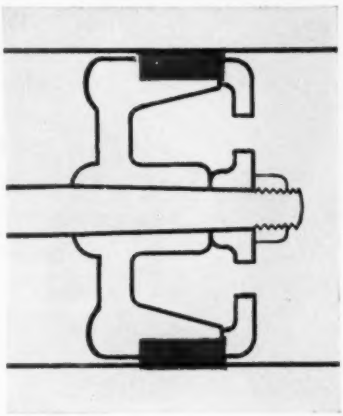
Ever since Du Pont "Teflon" tetrafluoroethylene resin was developed, its unique combination of properties has led to an ever-increasing use as a material for pump components—gaskets, packings, impellers, bearings. Among these properties—of particular value to manufacturers *and* users of pumps—are:

- **CHEMICAL INERTNESS.** Du Pont "Teflon" is completely inert to all chemicals and solvents, except molten alkali metals and fluorine at elevated temperatures and pressures.
- **HEAT RESISTANCE.** Capable of continuous service to 500°F.
- **LOW-TEMPERATURE TOUGHNESS.** Has been used satisfactorily to −320°F.
- **LOW COEFFICIENT OF FRICTION.** Either against itself or other materials.
- **EROSION RESISTANCE.** Resists erosion by impinging fluids.
- **ZERO MOISTURE ABSORPTION.**
- **NON-ADHESIVENESS.** The tackiest materials show little tendency to stick to "Teflon."

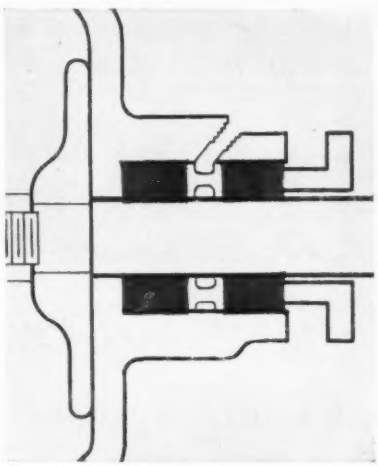
Illustrated opposite are some examples that show how pump components of Du Pont "Teflon" give outstanding performance and long service life . . . decrease production downtime . . . provide important savings in labor and material.

The Polychemicals Department of the Du Pont Company supplies "Teflon" in the forms of molding powders and aqueous dispersions. These forms are converted into various components for pumps, valves and other process equipment by a number of manufacturers. For further information, write: E. I. du Pont de Nemours & Co., (Inc.), Polychemicals Department, Room 2612 Du Pont Bldg., Wilmington 98, Delaware.

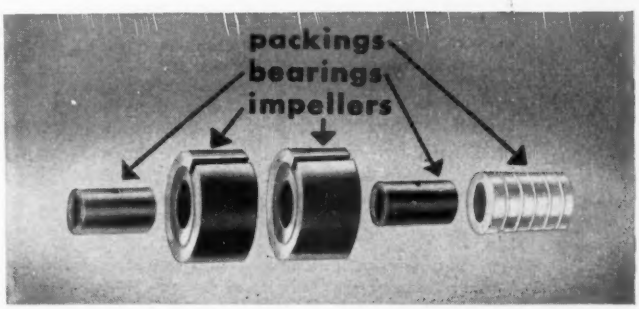
*REG. U. S. PAT. OFF.



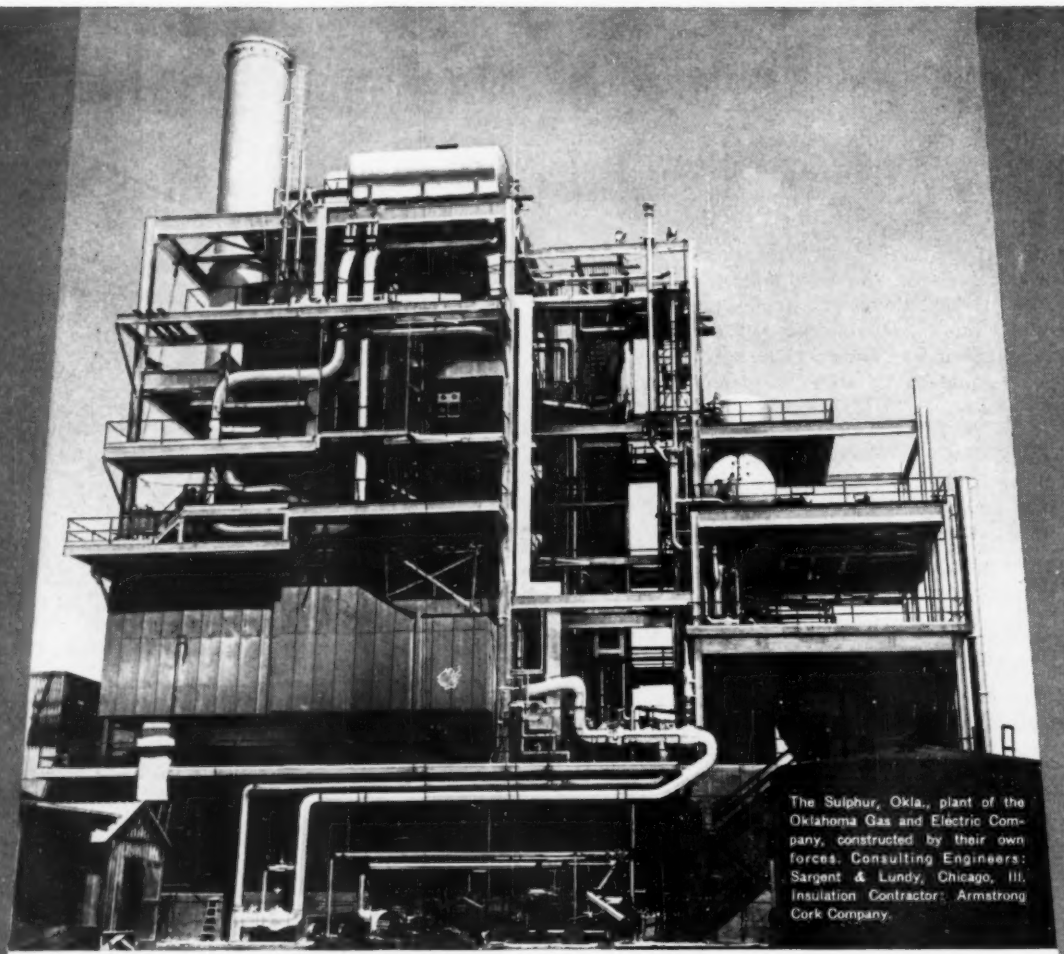
Ability to handle corrosive chemicals under extremely severe conditions is one of the advantages of gaskets and packings of Du Pont "Teflon." This horizontal duplex pump handles a 50% concentration of NaOH at 270°F. The service life of its packings used to decrease steadily from 73 to 16 days as its cylinder became badly scored. After the cylinder was honed and packing rings of Du Pont "Teflon" were installed, these rings were still in good condition with no signs of wear on cylinder or packing after 5 months' operation.



Gains in productivity often outweigh the cost of replacing packing with Du Pont "Teflon." This centrifugal pump (having a 2-in. shaft operating at 3,500 rpm) would leak badly when pumping hot "butyl extract." With a packing of "Teflon," leakage was reduced considerably. The shaft sleeve used to need replacement every few days—now it stays in good condition over several months' operation.



EXCELLENT PERFORMANCE is assured with impellers and bearings of Du Pont "Teflon." When a positive-displacement pump is equipped with impellers, bearings and packings of "Teflon," the pump can usually handle a much wider range of chemicals. These impellers are strong enough to withstand high tangential loads. They won't gall, shrink, swell, crack or harden. The bearings need no lubrication and won't become pitted even when operated in acids. The packings, too, give long, trouble-free service.



The Sulphur, Okla., plant of the Oklahoma Gas and Electric Company, constructed by their own forces. Consulting Engineers: Sargent & Lundy, Chicago, Ill. Insulation Contractor: Armstrong Cork Company.

They chose "Featherweight"® 85% MAGNESIA

TO INSULATE HEATERS, EVAPORATORS & STORAGE TANKS

To make their Sulphur, Okla., plant as modern and efficient as possible, Oklahoma Gas and Electric Company sought a modern, efficient insulation material. They found it in "Featherweight" 85% Magnesia, and used it extensively throughout the plant to insulate heaters, evaporators, storage tanks, and other equipment.

"Featherweight" 85% Magnesia is effective where temperatures do not exceed 600° F. Used in combination with K&M Hy-Temp Insulation (diatomaceous silica) its range is extended to 1900° F.

Hy-Temp is applied directly to the hot surface, and "Featherweight" is used as the second layer. The two layers are fitted with staggered vertical and horizontal joints—thus eliminating heat loss which occurs on single layer installations when the expansion of hot piping and equipment causes joints to open.

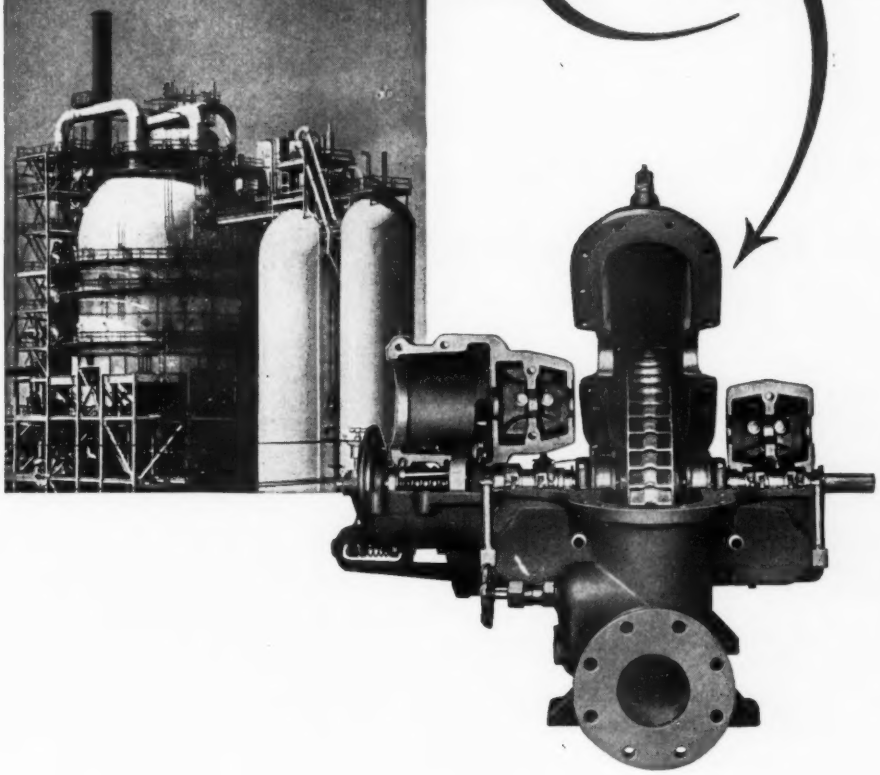
This K&M combination insulation will last the life of the equipment it serves, will withstand moisture, vibration, alternate heating and cooling, wetting and drying. Both materials are supplied in a variety of forms and thicknesses.

Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.

Nature made asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA
In Canada: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg, Vancouver

REFINERY has 101 ways to save money



When the yearly cost of replacement parts for 101 steam turbines averages *only 1.6% of the initial investment*, you are saving money . . . and plenty of it.

This amazing record was established by Terry turbines at a large refinery on the Atlantic coast. The percentage figure was determined by means of an accurate tabulation of the cost of replacement parts required over a two-year period.

These 101 Terry machines provide a good cross section of the various types of small and medium-size turbines made by the company. Ranging in size from 10 to 1200 horsepower, they include single and multistage axial flow designs as well as the famous Terry solid-wheel turbine.

Such outstanding performance records are not at all unusual for Terry turbines. The thousands and thousands of these machines installed in refineries throughout the world provide an accurate yardstick for measuring turbine reliability.

Send for illustrated bulletins. No. S-116 describes the many advantages of the Terry solid-wheel turbine. For multi-stage turbines, ask for a copy of Bulletin S-146.

TERRY

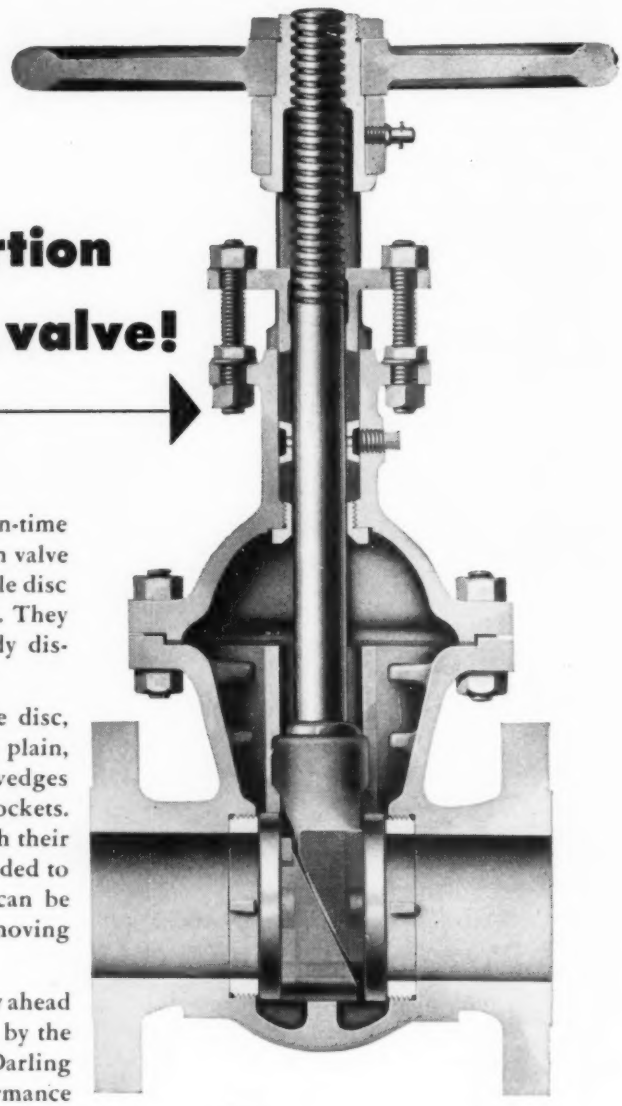
THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1194

DARLING VALVES

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

Valve body distortion no problem for this valve!



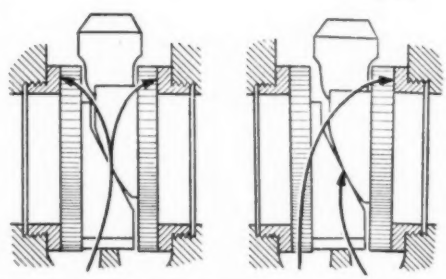
DON'T let costly valve maintenance and down-time headaches get you down! Lick these common valve troubles by installing Darling fully revolving double disc gate valves, with their unique wedging principle. They adjust *automatically* to compensate for valve body distortion—cinching tight, leak-proof closure.

The difference is in the fully revolving double disc, parallel seat principle of Darling valves. Just two plain, interchangeable no-pocket discs and two rugged wedges do all the work. Discs are completely free of pockets. Sediment and scale cannot collect to interfere with their free movement. No links or other devices are needed to hold the discs and wedges together. Any part can be quickly and inexpensively replaced without removing valve from the line.

It's easy to see why Darling valve users are money ahead because of the exceptional service made possible by the Darling design. That's why in plant after plant Darling gate valves are giving longer, trouble-free performance with minimum attention.

Darling features add up to gate valve service at its low-cost best! Send for the free Darling Valve Bulletin, today.

NOTE: Darling gate valves are made in a wide range of sizes, types and constructions, including solid and slotted taper-seat wedge types for all kinds of normal and corrosive services in pressures up to 1500 pounds.



Discs and seats are parallel.

Seats are forced out of parallel by body distortion but discs adapt themselves to give positive closure.

Radiused face of wedge allows discs to adjust tightly against both seats.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd. Galt 19, Ontario

SOMEDAY . . . *it will be for real!*

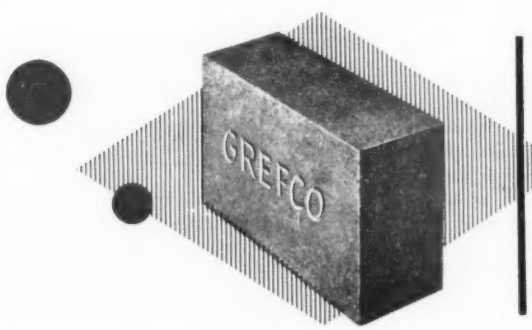
Building with blocks is as much a part of a young boy's life as baseball will be in his teens. Blocks—one on top of the other—to satisfy the typically male urge to create.

As the years roll by, this boy will go on to build bridges or buildings, to make his career in the laboratories of chemical research—or to watch steel being born from ore and earth.

Whatever his future, there will be refractory brick to help him do his job. Blocks of brick to line the furnaces and heat containing vessels—in virtually every step of industry.

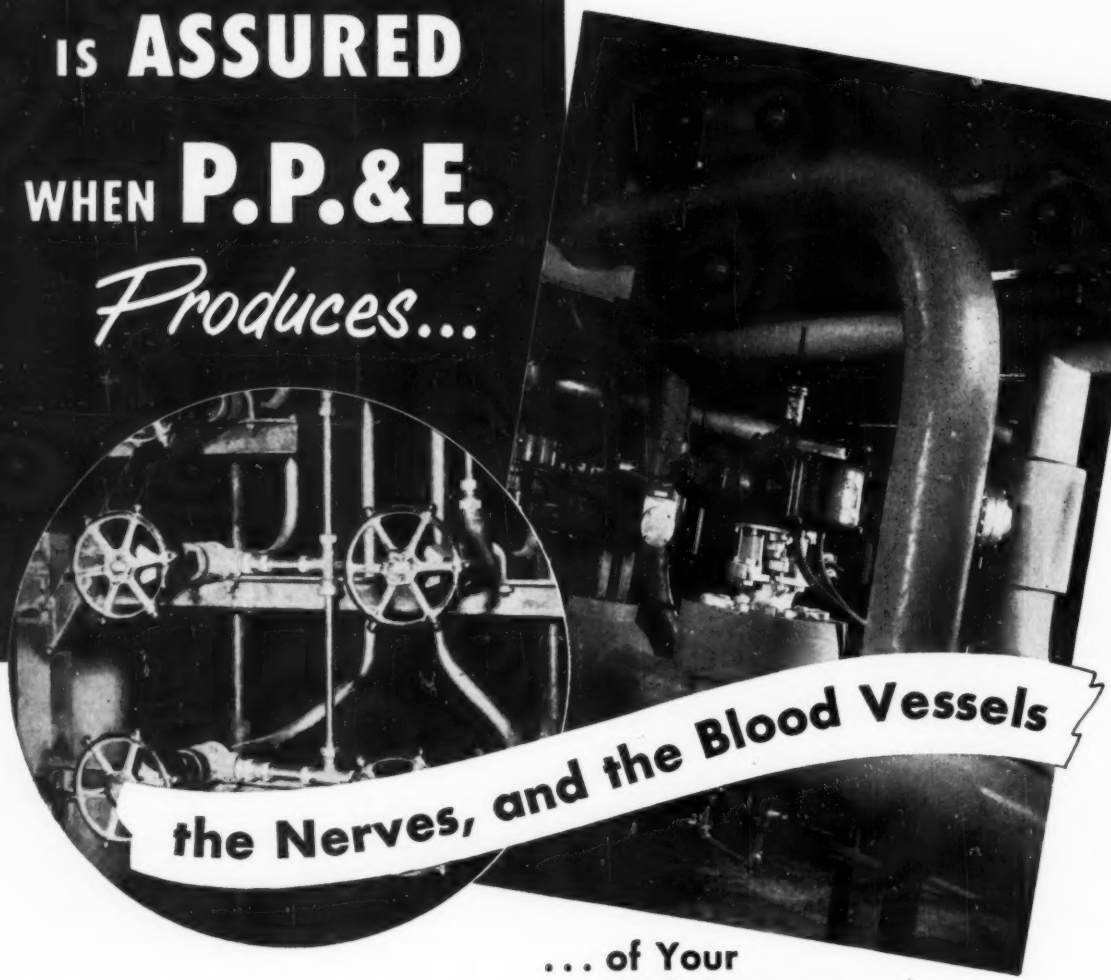
There would be no processed raw materials, no production, no living such as we know it but for refractory products which Grefco furnishes in quality and quantity to keep the nation on the move.

To the boy above, a very Merry Christmas and a great many Happy and Prosperous New Years. In his hands lies the future of America.



GENERAL REFRACTORIES COMPANY
Philadelphia

LONG LIFE IS ASSURED WHEN P.P.&E. *Produces...*



the Nerves, and the Blood Vessels

... of Your High Pressure High Temperature Piping System

The blood-vessels (main lines) and the nerves (control lines) of a power piping layout are equally essential to keep the entire system "full of steam."

And — the material from which the piping is made — and the way it is put together — will determine the efficiency and longevity of the system.

It's possible for a strong man to be a "physical wreck" because of a deficiency in his nervous system — and it's just as possible for a power plant to perform erratically because of inefficient engineering and installation of accessory piping.

P.P.&E. is just as careful to build sound "nerves" into a power piping system as it is to provide strong "blood vessels."

Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street — Pittsburgh, Penna.

Atlanta ... Whitehead Building	Houston ... Neyhts State Bank Bldg
Boston ... 10 High Street	New Orleans ... P. O. Box 74
Chicago ... Peoples Gas Building	New York ... Woolworth Building
Cleveland ... Public Square Building	San Francisco ... 785 Market Street

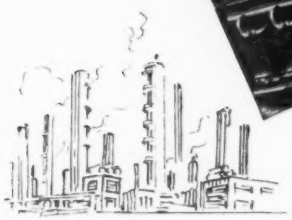
THIS 400,000 Pounds per HOUR

Vogt

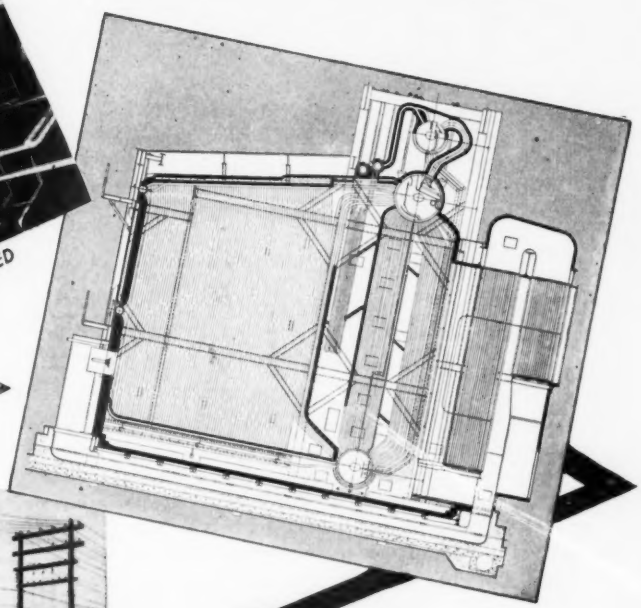
STEAM GENERATOR

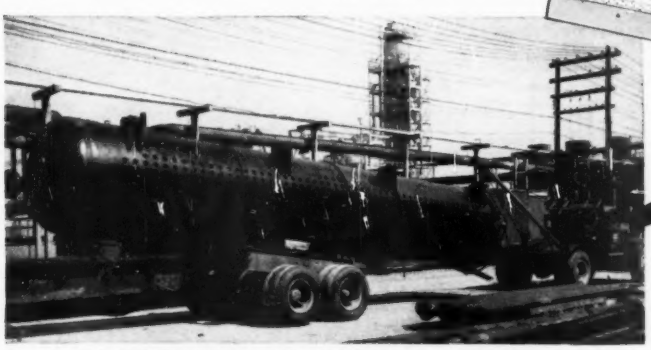
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT →
LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

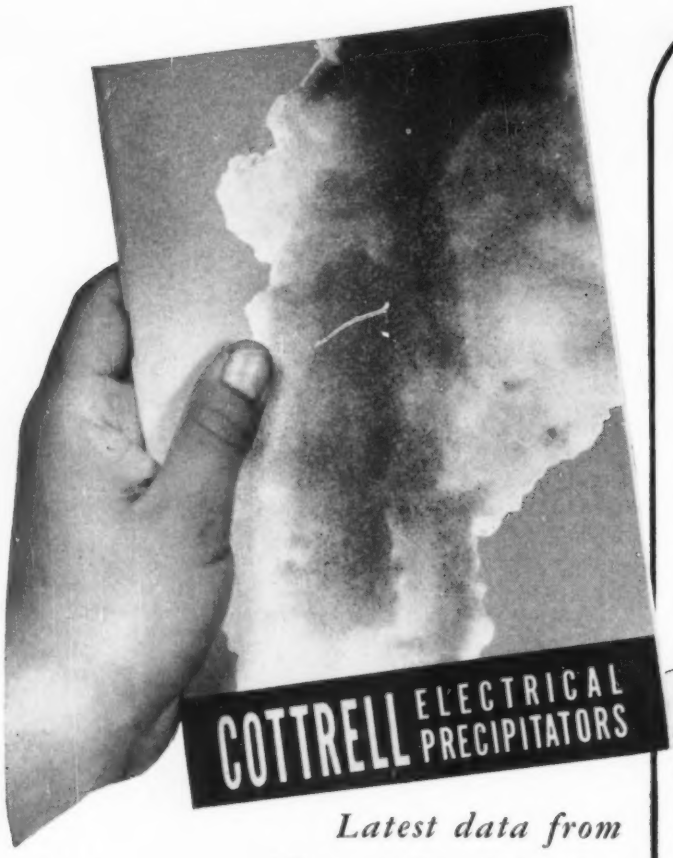
Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.



40 PAGES of helpful information

on Recovering Dusts, Fly Ash, Mists, Fumes and other Suspensions from Gases.

This booklet summarizes

the important points design and plant engineers should know about Cottrell Precipitators . . .

- Basic types of Cottrell equipment.
- Principal elements in a Cottrell unit.
- Data on Mechanical and Electronic Rectifiers.
- Various types of Collecting Electrodes (rod curtains, corrugated plates, pocket electrodes, etc.).
- Typical ways of removing collected material.
- Various Shell Constructions (steel, concrete, brick, etc.).
- The effect of various factors on efficiency and performance.
- Data on CMP (Combination Multiclone-Precipitator) Units.

. . . and many other helpful facts on Cottrell design and operation.

Latest data from Western Precipitation on Cottrell Recovery Equipment

Do you have operations in your plant where gas-laden suspensions, wet or dry, are a problem? Such suspensions may be dropping on surrounding property, causing nuisance difficulties. Or perhaps important values are being lost in stack gases that can be profitably recovered. Whatever the nature of your recovery requirements, you will find this 40-page Cottrell booklet of great help. It contains up-to-date data on the latest advancements in the electrical precipitation field – prepared by the organization that pioneered the commercial application of Cottrell Electrical Precipitators almost a half century ago and has consistently led in new Cottrell developments.

A copy of this data-packed booklet will be sent free to engineers and other executives interested in recovery processes. Send your request to our nearest office.

For nearly 50 years Western Precipitation has carried on a continuous research and development program on Cottrell Electrical Precipitators, Multiclone Mechanical Collectors and other types of recovery equipment. We are not affiliated with any other company in the electrical precipitation field except our wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. We are equipped to serve you anywhere in the United States, Canada, and throughout the world!

WESTERN Precipitation CORPORATION

DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1049 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA

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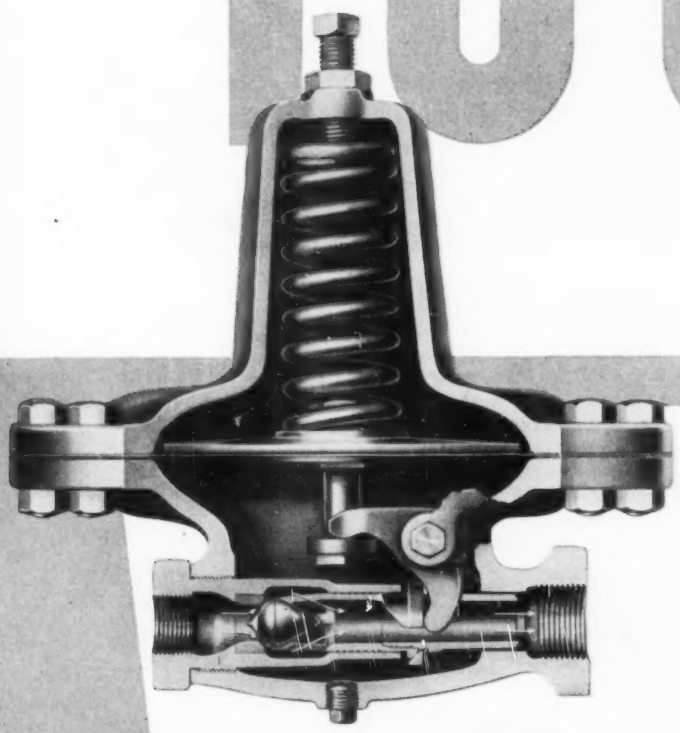
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

TYPE 1000 VALVE



Any product of quality should be dependable when *ordinary* products fail. Sudden pressure fluctuations, dirt, scale and viscous matter prove "fatal" to ordinary pressure reducing valves.

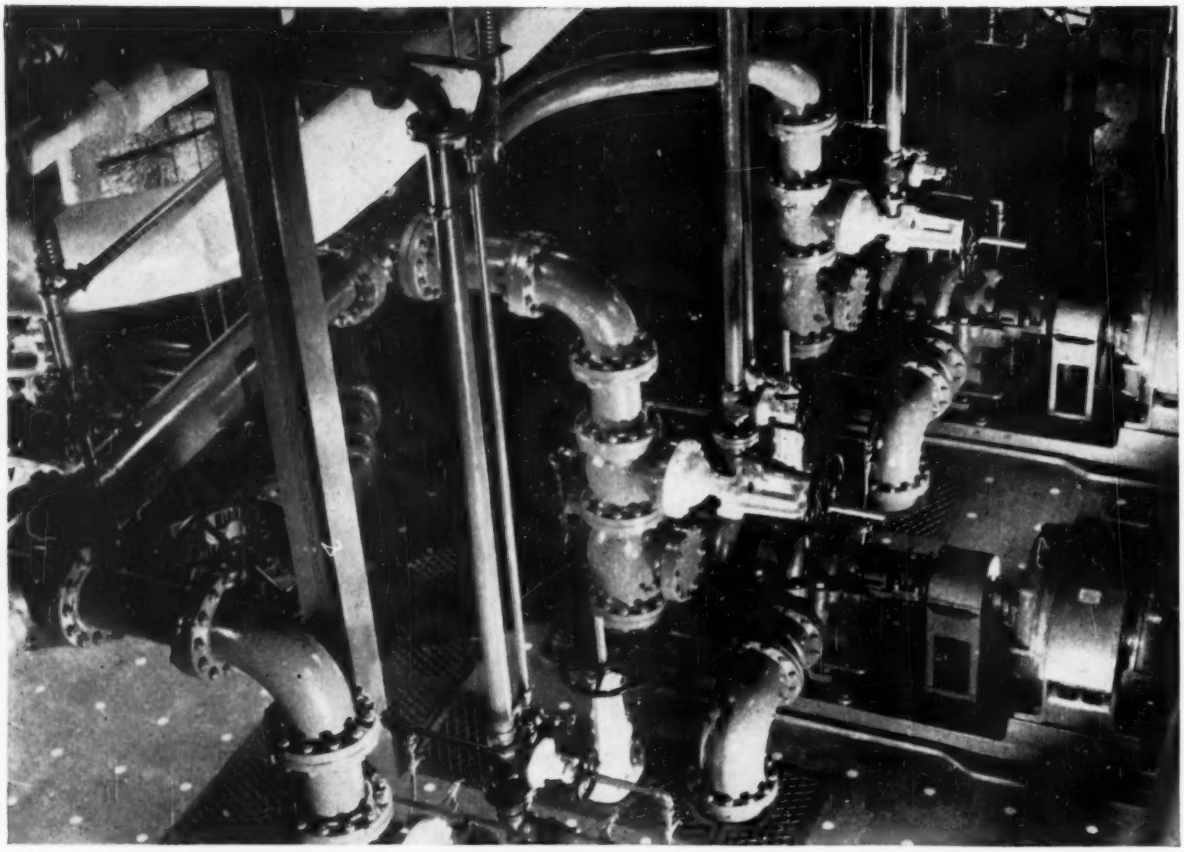
The CASH STANDARD TYPE 1000 VALVE however, is designed to operate with complete dependability under the most difficult and unusual circumstances. Many of these units have been in service over 10 years and have never been taken "out of the line."

Truly an *EXTRAORDINARY* achievement of quality and design excellence.

INSTALL CASH STANDARD "TYPE 1000" VALVES

CASH STANDARD **DECATUR, ILLINOIS**

A. W. CASH COMPANY



STUD-AND-NUT TEAM
GIVES LONG SERVICE AT HIGH TEMPERATURES

Looking for economical fasteners? The kind you can use for long periods of time in high-temperature, high-pressure bolting jobs? Then it's time to use the Bethlehem Continuous-Thread Stud, together with two Bethlehem Quenched Nuts.

This popular stud-and-nut team is economical because it resists premature failure caused by high temperatures and pressures. It pays for itself over and over again by effectively minimizing down-time.

We shall be pleased to answer any question you may have about the use of Bethlehem Studs and Nuts in difficult bolting applications. Your letter, addressed to the nearest Bethlehem office, will receive prompt attention.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

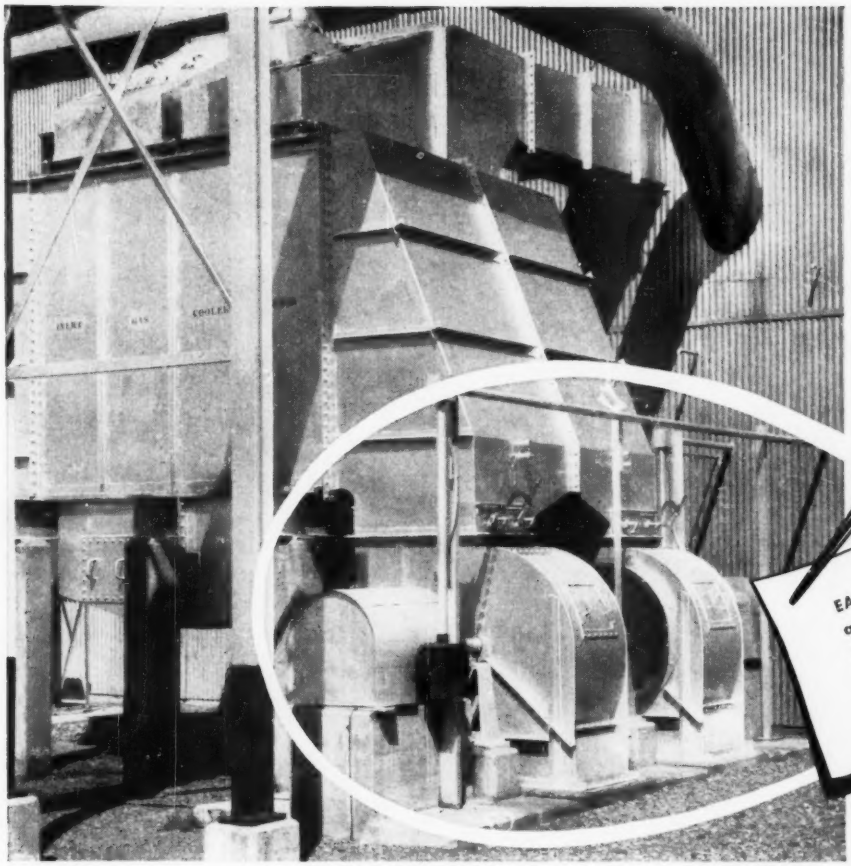
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM CONTINUOUS-THREAD STUD—*Has no point of thread run-out, thus eliminating that source of stress-concentration. Instead, stresses are distributed along full working length of stud. Made from carbon or alloy steel. Comes plain or heat-treated.*

BETHLEHEM QUENCHED NUT
Made from .40 to .50 carbon steel. Forged and extruded in forming die, then quenched and tempered. Develops the full strength of any stud or bolt.

Bethlehem supplies every type of Fastener



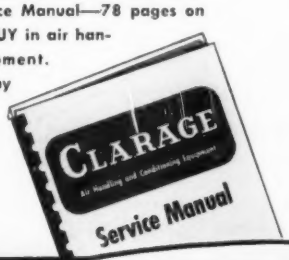
EACH FAN delivers 34,000 c.f.m. against 9.5 inches static pressure at 4800 feet elevation. Each fan is equipped with Clarage Vortex Air Capacity Control—an exceptionally economical installation.

Where Fan PERFORMANCE is Important

AS IN THIS FORCED DRAFT INSTALLATION

the Wise Choice is CLARAGE

VALUABLE DATA: The secrets of Clarage superiority are fully explained in this Service Manual—78 pages on your **BEST BUY** in air handling equipment. Write for copy today.



Another Clarage installation out-of-doors! The two Type W Fans shown above furnish forced draft to boilers in the field processing plant of the Stanolind Oil and Gas Company, Powell, Wyoming.

Through winter's cold and summer's heat, these fans must give round-the-clock, uninterrupted service.

Unprotected fan equipment to function properly must be good! From past experience over many years, the consulting engineers and the boiler people KNEW that they could recommend Clarage without reservation.

Yes, regardless of operating conditions—indoors or out—**you can RELY on Clarage Fans** to provide economical service for a long time to come.

You can Rely on...

CLARAGE

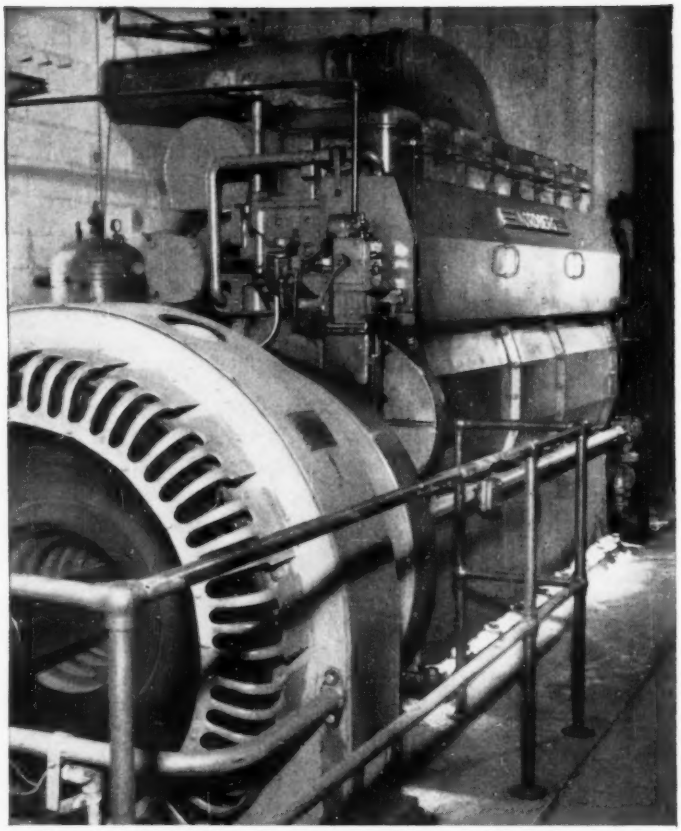
Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

MORE POWER AT 50% LESS OPERATING COST

NORDBERG DUAFUEL® ENGINE increases capacity and stabilizes scrap yard operations

Your power problems may not involve electromagnets—but remember there are Nordberg Diesel, Duafuel® and Spark-Fired Gas engines built in sizes up to more than 10,000 hp—to meet practically every power requirement. Write for details, outlining your power needs.



Ever watch a lifting magnet in operation? Their fluctuating operation—from *no* load to *full* load in a matter of seconds, calls for a steady, reliable source of power—power that can stand the gaff of this kind of "up-and-down" service . . . *the kind of power you get with Nordberg Duafuel® engines.*

For proof, ask Consumers Steel & Supply Company, operators of one of the largest scrap yards in the Midwest. Here's what they did . . . to avoid expensive plant outages and provide more efficient, lower cost power generation, this progressive company installed a 530 hp Nordberg supercharged Duafuel Diesel engine driving a 320 kw generator. This single Nordberg engine took over the plant's power demand from three 66 kw high speed Diesel units. *The results:*

(1) Generating costs cut almost 50%; (2) Immediate response to changing load conditions; (3) Ability to operate balers, shears and cranes and magnets at full capacity—16 hours a day, 6 days a week; (4) Sufficient reserve for plant expansion.

Although of Duafuel design, the Nordberg engine is now operating on straight Diesel fuel. Further economies will be realized when gas availability will allow full Duafuel operation.

Nordberg Mfg. Co., Milwaukee, Wisconsin

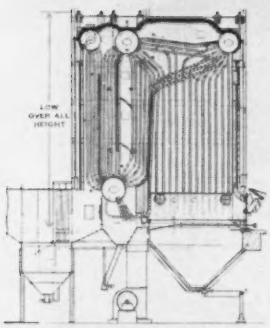
NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

Builders of America's Largest Line of Heavy-Duty Diesels

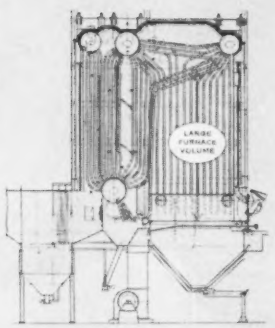
P153

Add the Advantages...



3. LOW OVER-ALL HEIGHT

+

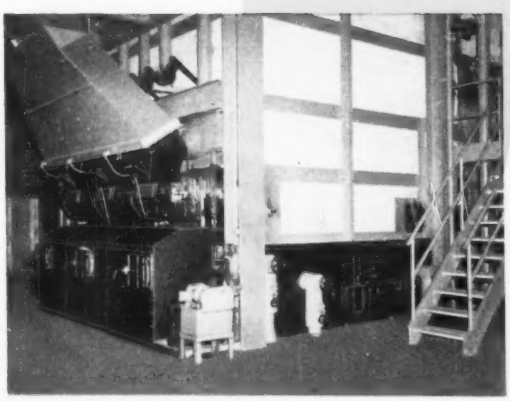


4. LARGE FURNACE VOLUME

=

Formerly, to get desirable large furnace volume in a watertube boiler you had to accept an awkwardly high over-all height. Now, BROS offers this large furnace volume within conservatively low over-all height, largely through compact vertical design of elements. Thus your boiler room space is utilized most effectively. A BROS boiler gives you maximum furnace volume and maximum flame travel per foot of over-all height!

You'll Choose BROS



Shown here is a BROS 4-drum Watertube Boiler installation at the municipal plant of a progressive midwestern city. Plant produces heat and generates electric power.

Before you specify your next steam generating unit, talk to a man from BROS. He can tell you concisely what a BROS-designed watertube boiler offers you. Two of the points are illustrated above. Since 1888 BROS engineers have specialized in these features which make boilers deliver the most steam for the least money in a specified application. Many of these BROS advantages are exclusive. Find out how they can serve you!

Second in a series of ads describing BROS advantages, point by point. ADD THE ADVANTAGES... YOU'LL CHOOSE BROS!

BROS

Power Division: **WM. BROS BOILER & MFG. COMPANY**
1057 Tenth Ave. S. E., Minneapolis 14, Minnesota

DESIGNERS AND MANUFACTURERS OF 2, 3 AND 4 DRUM WATERTUBE BOILERS, SUPERHEATERS, AIR HEATERS, ECONOMIZERS, ACCESSORIES, AUXILIARIES, PLUS A FULL LINE OF HEAVY-DUTY STOKERS

No job is too unusual for NAVCO

Whether you require a simple pipe bend or a complicated prefabricated assembly Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • BUFFALO • CINCINNATI

Keeps you out of trouble

UNIBESTOS®

PIPE INSULATION

Won't pulp, powder, crack, or wash off . . . resists impact and vibration . . . retains initial form and efficiency indefinitely. Jobs done with Unibestos are never undone either by time or the elements.

UNIBESTOS
IS RUGGED.
IT STAYS
ON THE JOB

UNARCO

UNION ASBESTOS & RUBBER COMPANY

DEPT. C-12, 332 SOUTH MICHIGAN AVENUE, CHICAGO 4, ILLINOIS

Immediate delivery from stock!

When buying gauges ask for USG . . . where a most diversified stock awaits your selection. USG Gauges are stocked for your convenience. You can order any of a wide variety of instruments—233 types, dial sizes, and size ranges—without delay. Many of these gauges are obtainable immediately from the local stock of distributors of USG Gauges in principal cities throughout the United States. Or they may be ordered through your USG distributor directly from factory stock at Sellersville, Pa. Take advantage of this fast delivery service. Call the distributor of USG Gauges in your locality today for information on gauges. United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Pa.

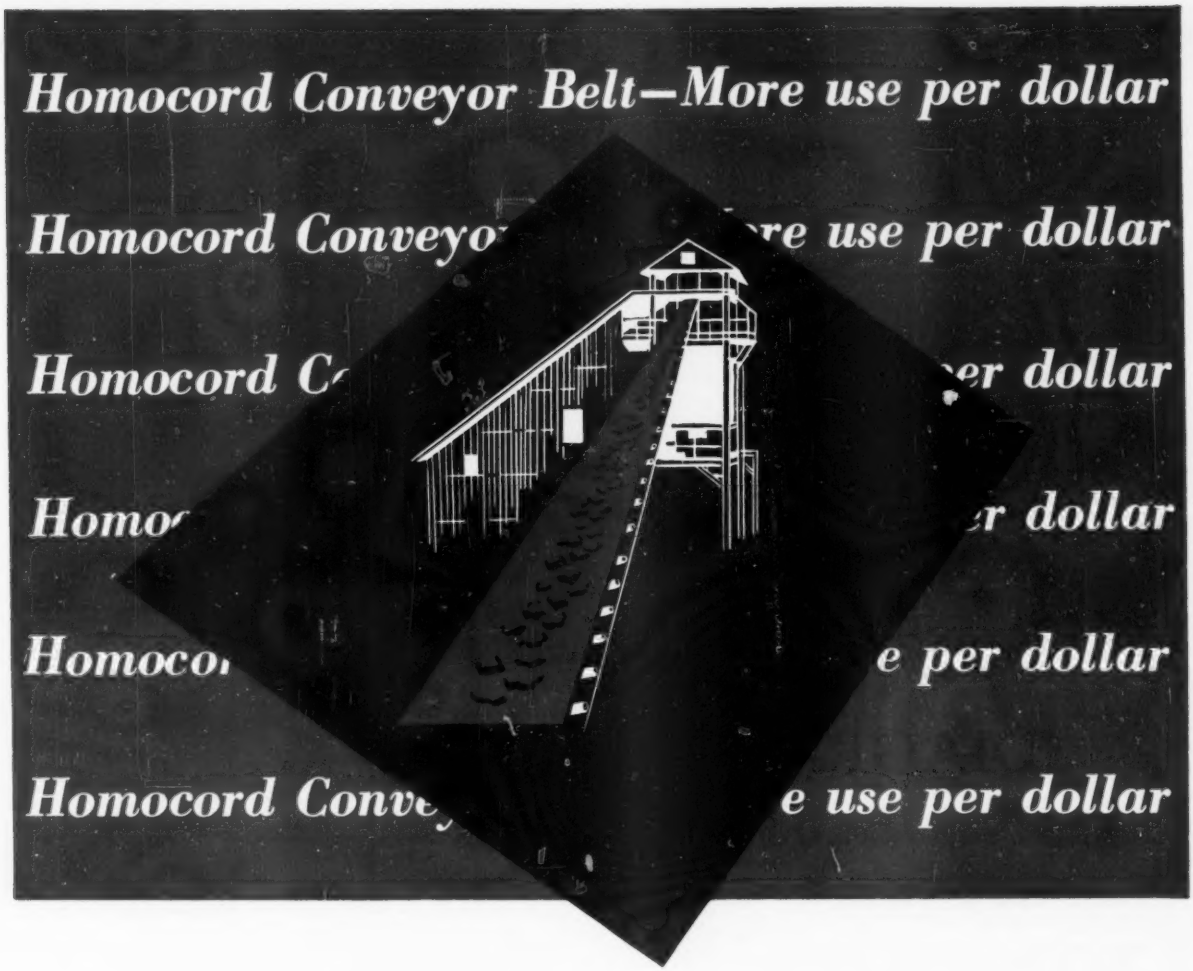
Three of the many types and sizes of USG Quality Gauges now carried in stock

UNITED STATES GAUGE

Quality Gauges Engineered for Enduring Accuracy

PRODUCTS OF UNITED STATES GAUGE... Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • Altitude Gauges • Boiler Gauges Chemical Gauges • Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors' Test Gauges Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges.

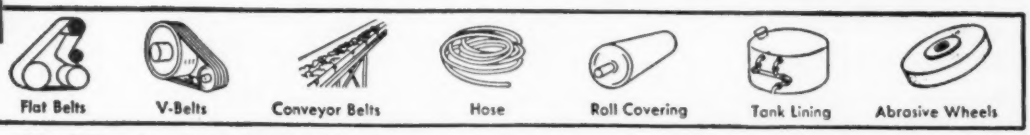
OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC. AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS


Homocord Conveyor Belt—More use per dollar
Homocord Conveyo re use per dollar
Homocord C er dollar
Homo r dollar
Homoco e per dollar
Homocord Conve e use per dollar

CUSHIONED THROUGH AND THROUGH . . . To take the impact of heavy loading. That's why you get more ton-miles of service out of Homocord Conveyor Belt. This resilience withstands the abrasion and gouging of jagged rock, coal and ore. Its flexibility makes it a naturally deep troughing belt that trains easily on the idlers . . . able to haul heaping loads without edge-wear or spilling. Another R/M Conveyor Belt, Ray-Man "F", is designed for underground mining where pulleys are small and great flexibility and tear resistance are needed. Both of these R/M belts give you long life on the job, MORE USE PER DOLLAR. Ask the R/M distributor for Bulletins 6906 and 6915. R/M field engineers back him up, to give you MORE USE PER DOLLAR—not only in conveyor belts, but in hose, transmission, and V-belts.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls

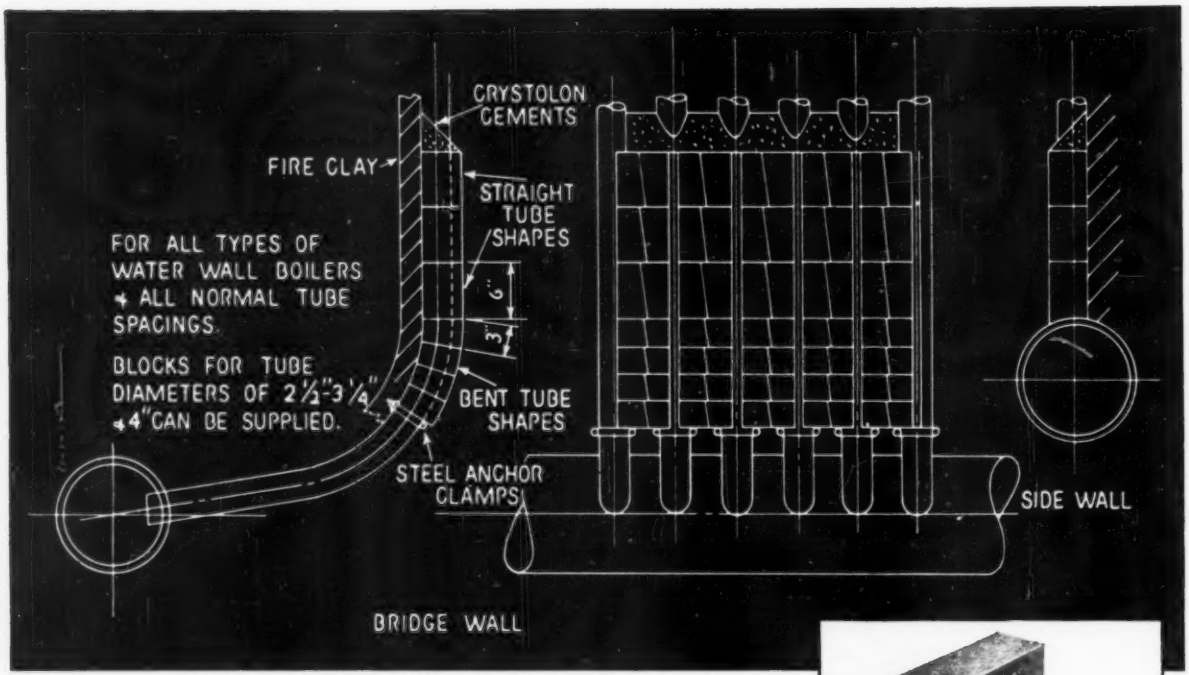
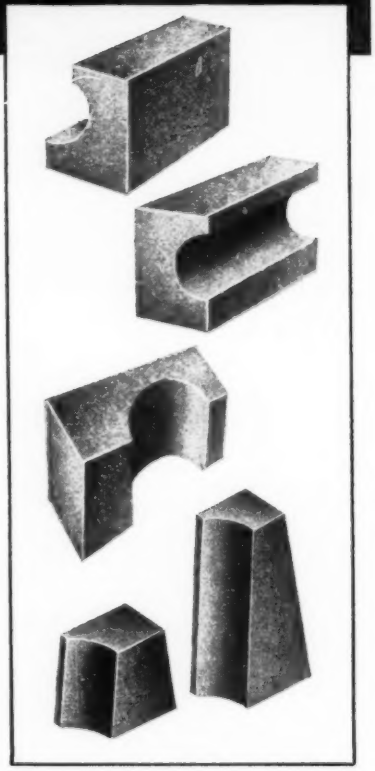


DIAGRAM FOR LONG BOILER LIFE

... and a formula for fewer shutdowns

CRYSTOLON* *Armor Blocks*



*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

The way to get the most out of water tube boilers is to give them CRYSTOLON Armor Block protection.

CRYSTOLON Armor Blocks are made to afford maximum protection to tubes from localized heat generation and flame impingement. They're tapered for secure locking and to maintain intimate contact with the water tubes. They can be replaced readily from the fire side of the boiler.

You'll get these advantages

1. Ability to stand up under high heat (up to 3050°F).
2. Virtually impervious to slag penetration.
3. Practically clinker-proof.
4. Stand up under abrasion caused by the moving bed of stoker-fired furnaces.
5. Installation easy and inexpensive.

And when you need cement, call for Norton CRYSTOLON cement for laying up bricks — and for air-cooled wall construction. The time between shutdowns will be the greatest you have ever experienced.

Bulletin Sent Free

For more information about CRYSTOLON Refractories for Boiler Protection, write for Bulletin 862 NORTON COMPANY, 451 New Bond St., Worcester 6, Massachusetts.

Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

NORTON

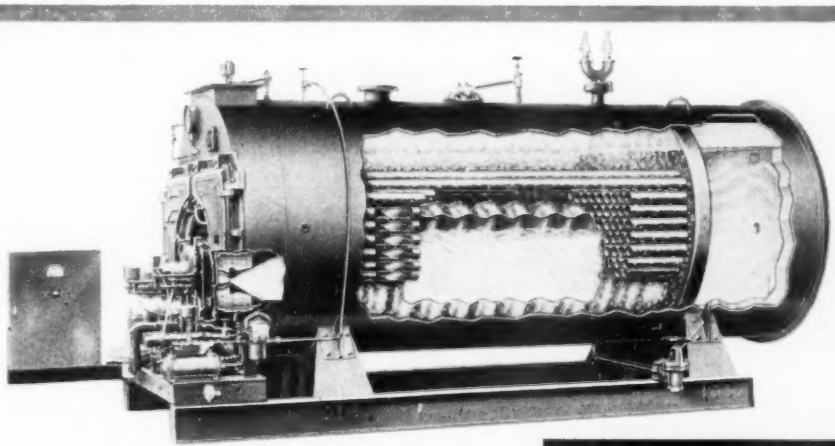
Special REFRACTORIES

Making better products... to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

2 heads are better than 1 ... ...in designing boiler-burner units

■ It is just common sense that experts in any field thoroughly know their own products. So you can expect a better product in every way when you specify the Kewanee-Petro Boiler Burner Unit because you get the combined knowledge of leadership in 2 fields . . . boilers and burners. Here, two great companies bring together boilers and burners designed as complementary units with all parts perfectly integrated. Engineering and design have been combined for maximum efficiency and dependable production of high or low pressure steam and hot water heating using oil, gas or oil and gas combination. The Kewanee-Petro Unit is easily installed . . . simple to operate. The boiler, mounted on steel skids, has matched burner connections. All refractories are installed at the factory . . . forced draft burner eliminates necessity of a high stack . . . operation is completely automatic with all combustion controls mounted and pre-wired in one cabinet. Delivery from two separate factories offers important advantages. The boiler is usually wanted at the building site before the walls are up, and needing no protection from the weather, is shipped first. The burner, with control system, is delivered when wanted, after the building is roofed. It will pay you to get full information on this outstanding boiler-burner unit. Write either company, or mail the coupon.



KEWANEE—PETRO

boiler–burner unit

PETRO
3271 W. 106th Street, Cleveland, 11, Ohio

KEWANEE-ROSS CORPORATION
118 Franklin Street, Kewanee, Illinois

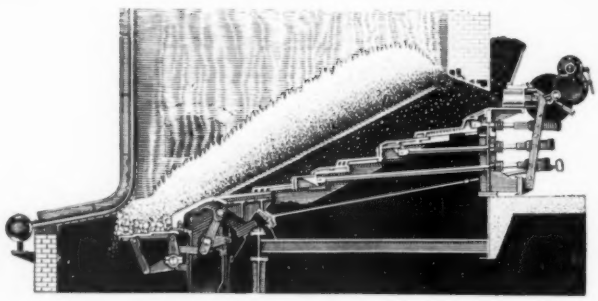
PETRO
3271 W. 106th Street, Cleveland, 11, Ohio
KEWANEE-ROSS CORPORATION
118 Franklin Street, Kewanee, Illinois

Please send 16 page catalog containing complete data and specifications.

NAME_____

ADDRESS_____

CITY_____ STATE_____



TAYLOR UNDERFEED STOKER

5 ways better than aspirin

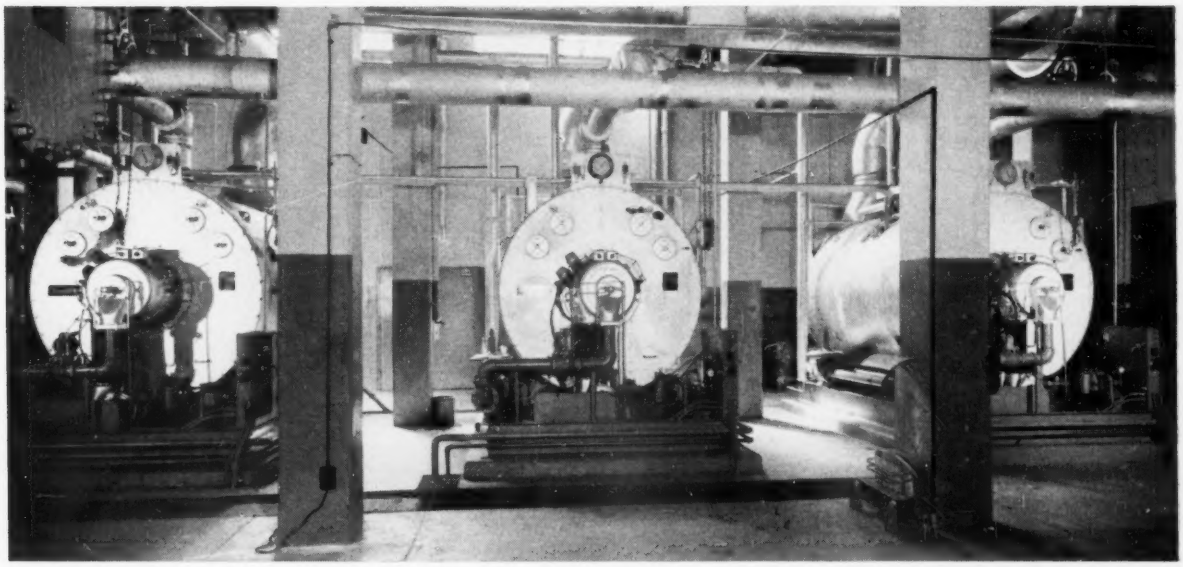
FIVE DIFFERENT HEADACHES have often been inseparably connected with stoker operation... and every one of them is eliminated by the modern, engineered AE Taylor Stoker.

CO_2? That's where Taylors give you unrivaled efficiency. *Quick load response?... complete dependability?* Taylor Stokers are completely tops in both respects. *Stack discharge nuisance?* Taylors meet the toughest municipal ordinances. With proper grate area, over 98% of the ash goes to the pit. *Burning versatility?* Properly proportioned, Taylors can and do burn coals satisfactorily from all over the U.S., and from Canada, England and the Continent as well.

Whether your new plant must generate 20,000 or 500,000 pounds of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us today for booklet telling the whole Taylor story.

AMERICAN ENGINEERING
COMPANY
2400 ARAMINGO AVE., PHILADELPHIA 25, PA.
IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA
AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

IN ALL TYPES OF BUILDINGS



This installation was made by Continental Engineers, Inc., mechanical contractors, of Atlanta. Gas is supplied by Atlanta Gas Light Company.

Powermaster® Efficiency Pays Off

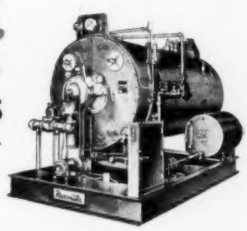
For example: Only $1.15 per month per apartment average fuel costs the year around for Heating, Hot Water and Air Conditioning for 535 apartments in Howell House at Atlanta, Ga.

These services in this new modern building are supplied by three *Powermaster* Packaged Automatic Boilers at this amazingly low cost for gas and oil fuel. Providing year-round services with the boilers result in maximum operating economy. Yet fuel saving is only one reason *Powermaster* is so popular with those who select, install and operate boilers for all types of buildings—offices, hotels, institutions, churches, housing projects, etc. Cost-saving installation, space-saving compactness, fast steaming, hospital-clean operation, dependability, maintenance-saving accessibility, fully automatic operating and safety controls, and smokeless combustion are others. Compare *Powermaster* with any other packaged automatic boiler and you'll see why it is today's best buy for schools, industrial plants, laundries, and other requirements as well as for all types of buildings. Send for latest descriptive bulletin.

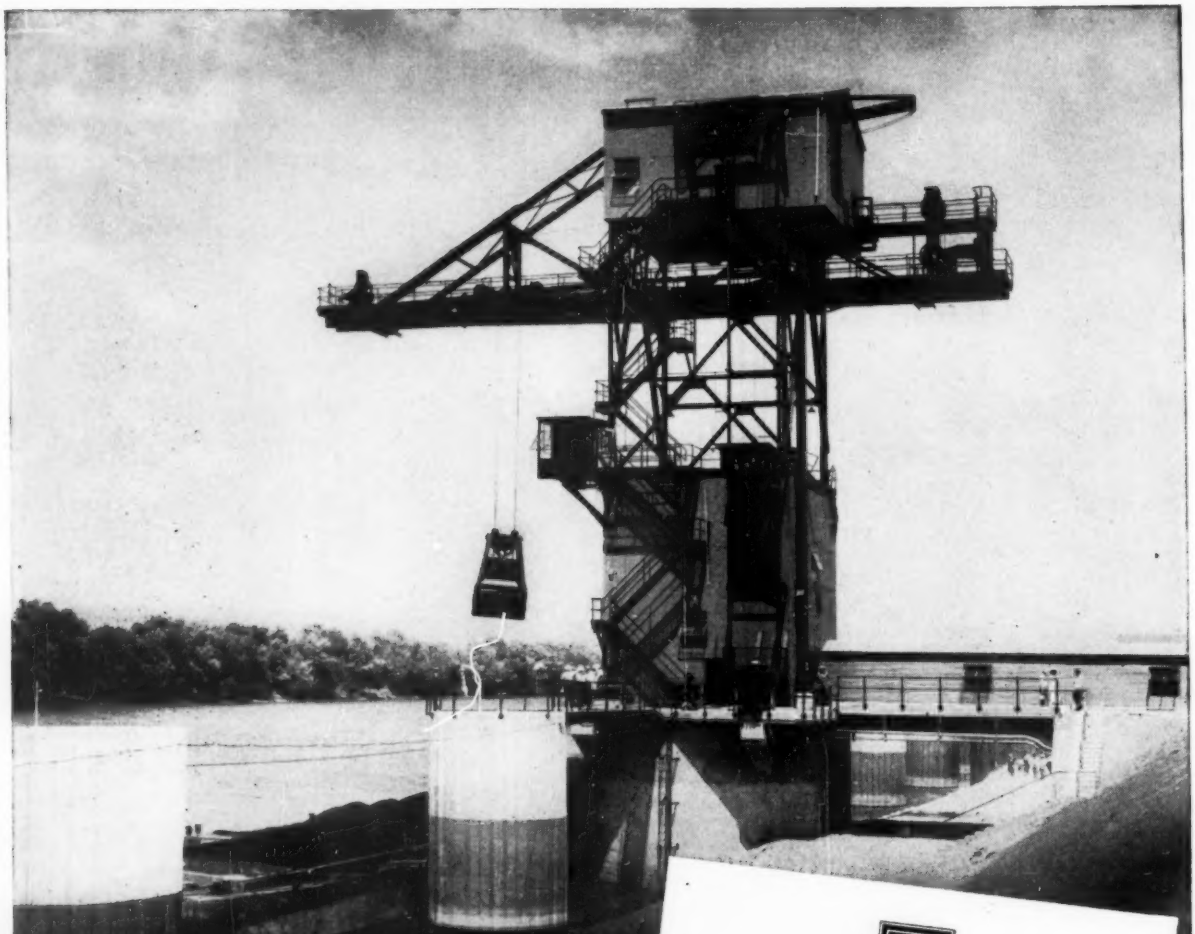
O&S Powermaster®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



ORR & SEMBOWER, INC. • Established 1885 • **Morgantown Road, Reading, Penna.**



This coal unloader for Illinois Power Company's new 75,000-kw Hennepin Power Station was designed and fabricated by Dravo Corporation to handle incoming barge shipments of coal.

The Dravo unloader is equipped with a 15-ton sliding counter-weight which works in conjunction with the hoist motor and performs one-half of the lifting job, producing a 670-ton-per-hour free-digging capacity on a 35-second operating cycle.

DRAVO

DESIGNERS *and* BUILDERS

BRIDGES AND UNLOADERS • TOWER-TYPE UNLOADERS
WHIRLER CRANES • FLOATING CRANES
DRAVO RAIL CLAMPS • BARGE SHIFTERS
MODERNIZED TROLLEYS FOR EXISTING BRIDGES

Many power companies and industrial plants have called on Dravo Corporation for similar installations. Why not make use of Dravo's more than 60 years of practical experience when planning a materials handling project?

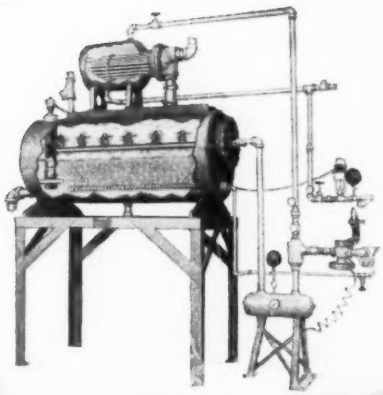
DRAVO
CORPORATION

NEVILLE ISLAND, PITTSBURGH 25, PENNSYLVANIA

AIR CONDITIONING • BOILER AND POWER PLANTS • CRANE CAB COOLERS • DOCKS • INDUSTRIAL FOUNDATIONS • OPEN STEEL FLOORING
PUMP HOUSES AND INTAKES • SPACE HEATERS • WATER AND WASTE TREATMENT PLANTS • TOWBOATS AND BARGES

a Fresh approach . . . a Major advance . . .

in boiler feedwater deaeration



SCHAUB ZERO-OXYGEN Deaerators

NEW DESIGN! NEW PERFORMANCE! NEW SAVINGS!

Complete Oxygen Removal (to .005 cc/liter) • Complete Safety and Dependability • Wide Range for Load Variations • High Thermal Economy • Low Maintenance Costs • Simpler Design for Trouble-Free Service

Start with an idea that's *basically* new and better. Then produce performance beyond the best that ordinary deaerators can deliver. Schaub engineers achieved it . . . developed the all-new deaerator that's a major advance in boiler feedwater deaeration!

Two basic differences give the Schaub Zero-Oxygen Deaerator its outstanding advantages . . . note them well. First, it provides *external* pre-heating to a temperature *above* boiling point, with over-atmospheric pressure held only up to the internal sprayer manifold! Second, a free, non-restricted vent liberates *all* air *immediately* with maximum vapor heat recovery!

From these simple fundamentals stems a whole series of all-important performance benefits. Every engineer or operating man concerned with boiler feedwater deaeration should have the full facts on all-new Schaub Zero-Oxygen Deaerators. Simply send the coupon to get the complete story — promptly.

FRED H. SCHAUB ENGINEERING COMPANY

2105 South Marshall Boulevard • Chicago 23, Illinois

FREE FACTS!
SEND COUPON TODAY
FOR BULLETIN 575

Tells why you need deaeration. Explains basic differences in deaeration systems. Here's the complete story on new Schaub Zero-Oxygen Deaerators.

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Boulevard, Chicago 23, Illinois

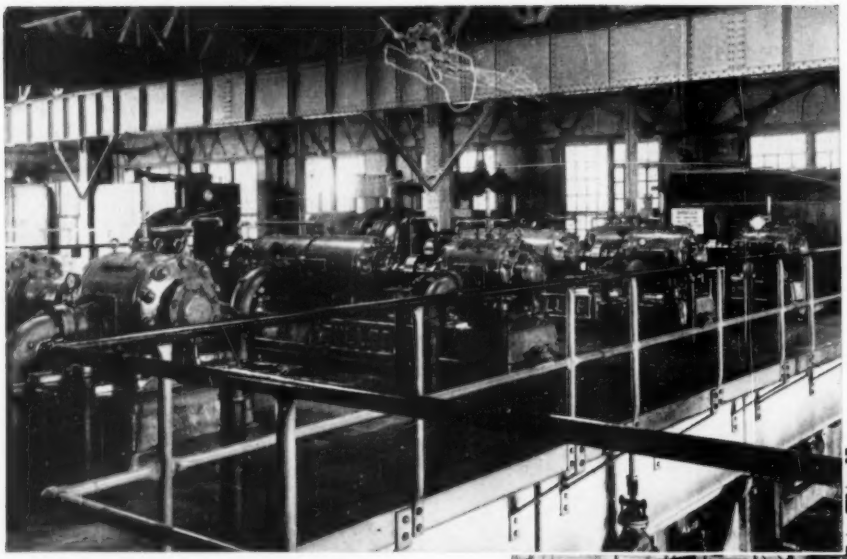
Please send me without cost or obligation, my personal copy of your new bulletin 575 on Boiler Feedwater Deaeration.

NAME_____

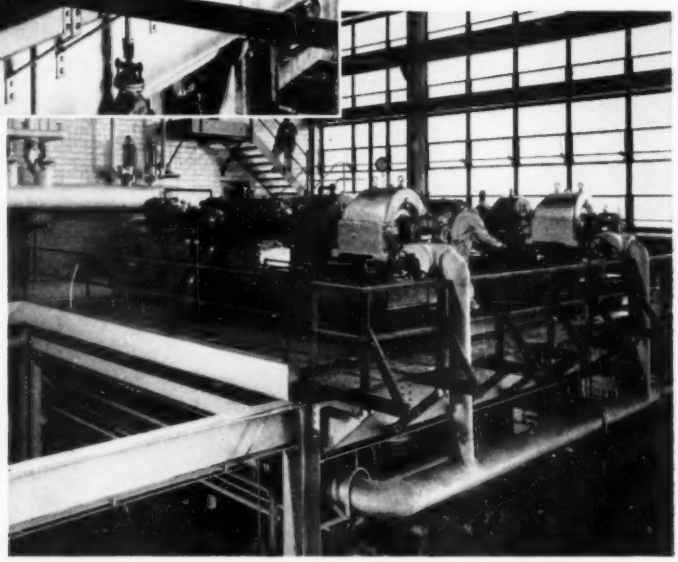
COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____



Views of Fuller Rotaries installed on balconies; overhead, out of the way. Left: Four two-stage; capacity each 1665 c.f.m., 100-lb. psig. Below: Two two-stage; capacity each 1592 c.f.m., 120-lb. psig.



Eliminate heavy, costly foundations with FULLERS

*** simple * compact**

*** direct drive * valveless**

*** vibrationless * pulseless**

If you've never considered the many outstanding advantages of Fuller Rotary Compressors and Vacuum Pumps, now is the time to do so.

Fullers have many unique and beneficial advantages for low cost operation. They can be placed almost anywhere out of the way, because their vibrationless, rotary action permits installation, for example, on a balcony or upper floor of a building . . . no heavy, costly foundations being required. Operated by direct drive, you reduce initial and maintenance costs, as well as transmission losses incident to gear and belt drives.

Because Fuller Rotaries compress without reciprocating motion the air-stream is, in effect, non-pulsating. They're extremely compact for volumes delivered; sizes are available to deliver up to 3300 c.f.m., actual free-air, for pressures to 125 psig., from atmosphere.

Write today to Fuller Company—have one of its compressor engineers recommend the *right* compressor for your operation—one that will give you life-time efficiency and capacity.

Fuller Pioneers of high efficiency vane-type rotary compressors

FULLER COMPANY
Catasauqua, Pa.

Branch Offices: Chicago • San Francisco • Los Angeles • Seattle • Birmingham

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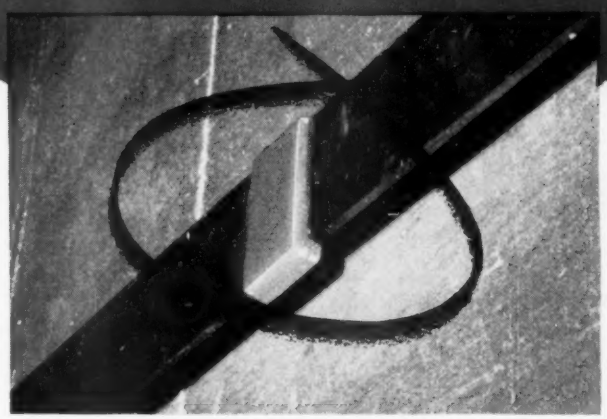
FOR ELECTRIFYING RESULTS

CADWELD®

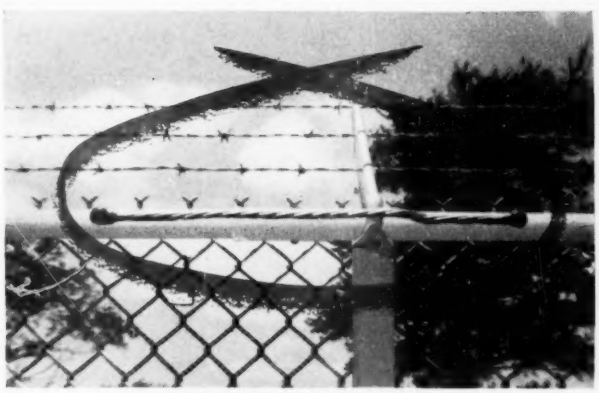


BUSBAR ⅛" x1"—½" x 8"

Design and field electrical engineers rate CADWELD the finest electrical connection on the market. Here are the reasons WHY!!!

1. CADWELD connections have more current carrying capacity than the conductor itself.
2. CADWELD connections cannot loosen or corrode.
3. Any shape or size conductor (copper or steel) can be CADWELDED with standard equipment.
4. Single CADWELD cartridges or combinations can be used for all size connections.
5. Equipment is portable — perfect for field use—no outside source of power or heat required.

For the best in
ELECTRICAL CONNECTIONS



CABLE TO STEEL ALL SIZES
CABLE #6—3,000 MCM

The Current Trend
IS
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☐ Send Descriptive Literature on CADWELD Electrical Connections

☐ Have Representative Call

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COMPANY _____

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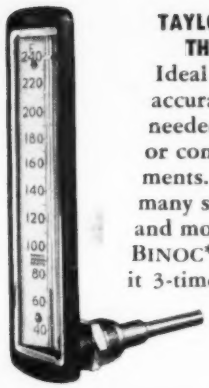
CITY _____ ZONE _____ STATE _____

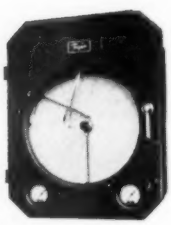
The Company Treasurer will love them!

WHY? Because these Taylor instruments will help you increase operating efficiency and cut costs. That's enough to warm the heart of the coldest finance man. Of course, these are only a few of the complete line we can offer you for better measurement or control of temperature, pressure, flow or liquid level. Ask your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.



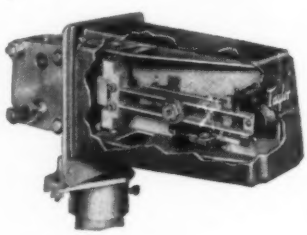
TAYLOR INDUSTRIAL THERMOMETER
Ideal wherever an accurate check is needed on recording or controlling instruments. Available in many standard ranges and mounting angles. BINOC* tubing makes it 3-times-easier-to-read.

RECORDING THERMOMETER OR PRESSURE GAUGE
Ideal wherever you need a record of pressure, temperature or a combination of both. For example, accurately records steam and feed water temperatures and pressures, or oil, air and flue gas temperature.

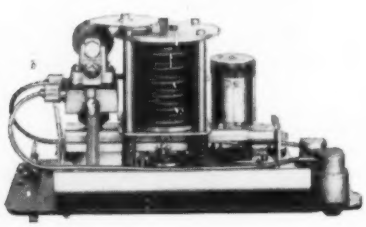


RECORDING FULSCOPE* CONTROLLER
For desuperheaters, or for any close, accurate control of temperature, pressure, flow or liquid level. Quickly adapted to operating requirements.

NEW 6" DIAL INDICATOR
For temperature and pressure measurements. Has an all-new design movement for greater sensitivity on any type of measuring job. New case can be flush or face mounted, is fume and moisture proof. Big selection of standard ranges.



TAYLOR TRANSAIRE* DIFFERENTIAL PRESSURE TRANSMITTER
A rugged, dependable and accurate instrument designed to measure flow, liquid level or specific gravity. Taylor's latest addition to TRANSET System of transmitters, receivers and controllers.



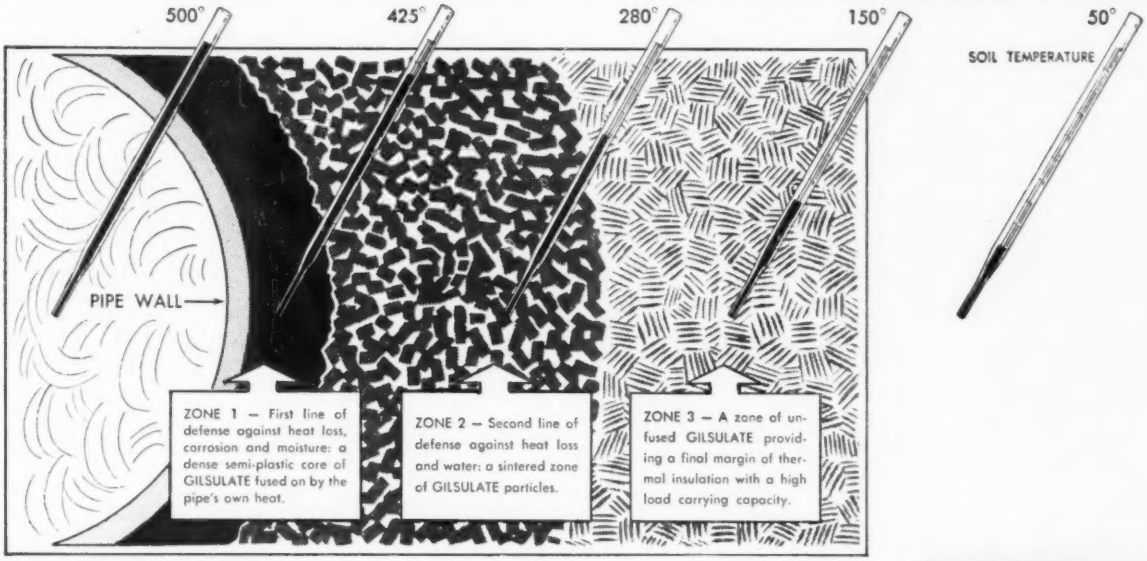
TAYLOR TRANSAIRE TEMPERATURE TRANSMITTER
Compact and super-responsive. Designed to measure and transmit smallest temperature changes up to 1,000 feet with great accuracy. Provides dynamic accuracy, thanks to derivative action in the measuring circuit. Similar instruments for highly accurate pressure measurement.

*Reg. U.S. Pat. Off.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

Lowest Cost

PER INSTALLED LINEAR FOOT OF ANY HOT UNDERGROUND PIPE INSULATION


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — First line of defense against heat loss, corrosion and moisture: a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.
ZONE 2 — Second line of defense against heat loss and water: a sintered zone of GILSULATE particles.
ZONE 3 — A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity.

GILSULATE®... the triple-zone insulation that fuses itself into lifetime protection for hot underground pipes. Water-proof, corrosion-proof, root-proof, acid/alkali-proof.

Compare your present insulation methods with Gilsulation:

1. Pour Gilsulate granules out of the bag onto the pipe; tamp it down.
2. Backfill: *the job is insulated!*

Gilsulate—nature's own insulation—is a unique, solidified hydrocarbon that virtually installs itself. Normal pipe-heat (up to 520°F) does the rest—fuses the Gilsulate to the pipe in hours, forming a massive circular solidified sheath.

Gilsulate costs less installed per linear foot *than any other underground pipe insulation*... it's easiest to use... and has been tested in scores of the country's largest and most important installations.

Some additional Gilsulate advantages:

- *3 grades available*—220° to 520° F
- *needs no sleeves* or mechanical sheaths
- *requires no mixing* or special handling
- *can't be punctured* — leave rocks in backfill
- *pipe expands and contracts* within Gilsulate structure
- *proved in actual use* in hundreds of new construction and replacement installations

Send coupon for descriptive literature.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

No skills necessary—simply pour Gilsulate out of 100 pound bags, tamp and backfill. Can be used under any and all conditions—no matter how many pipes, whatever the space.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES.

American Gilsonite Company
248 South Main Street, Salt Lake City 1, Utah
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on Gilsulate.

NAME .....

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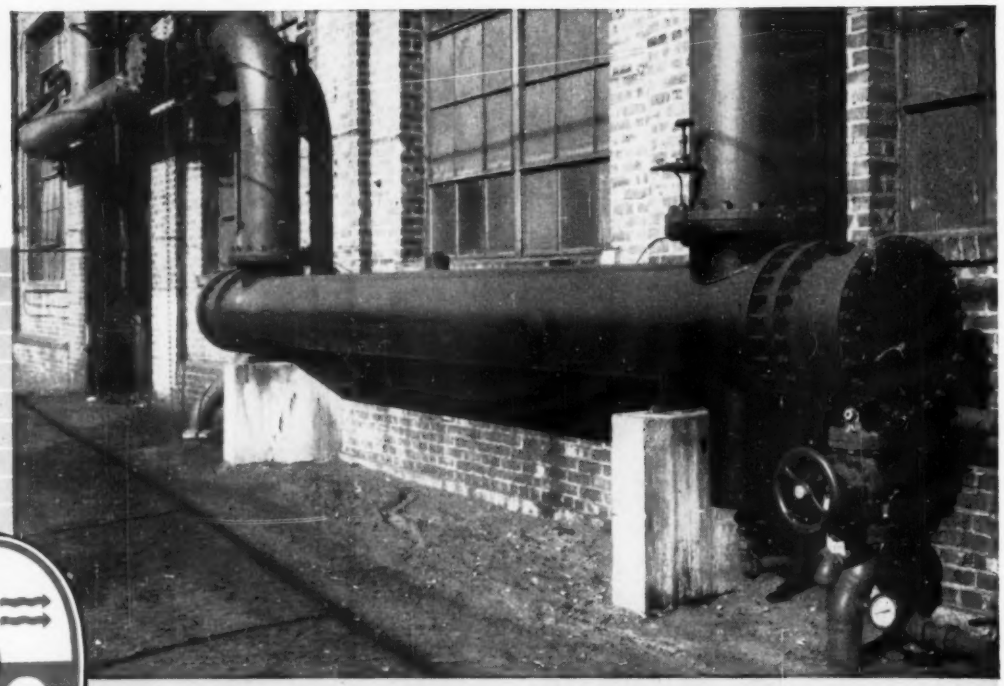


Installation of B & G Gas Cooler

Hydro-Flo HEAT EXCHANGERS

invite your critical appraisal of design and workmanship

Whether you require equipment of standard design or specially engineered units, B & G *Hydro-Flo* Heat Exchangers will stand up under any measurement of value you can apply. They are the sum of both practical field experience and continuous laboratory research and development.

The sound design of B & G *Hydro-Flo* Heat Exchangers is translated by modern manufacturing methods into units of proved efficiency . . . built to do the job well over a long operating life. The line is comprehensive—covering the numerous applications of heat exchangers in modern industrial plants.

The B & G engineering staff is always available for consultation on your heat transfer problems.

B&G Hydro-Flo shell-and-tube heat exchangers are available in the following types:

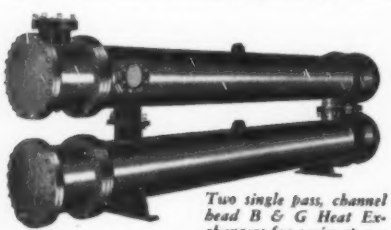
Straight and "U" Bend Tube Heat Exchangers . . . Fuel Oil Preheaters . . . Tank Suction Heaters . . . Aftercoolers . . . Gas coolers . . . Water Heaters . . . Refrigeration Evaporators and Condensers . . . Quench Oil Coolers.

BELL & GOSSETT

COMPANY

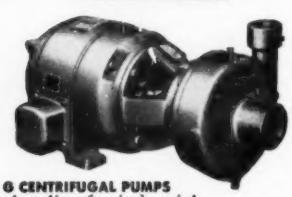
Dept. DF-36, Morton Grove, Ill.

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada



Two single pass, channel head B & G Heat Exchangers for series operation.

High pressure B&G Heater with fixed tube sheets and expansion joint design.



B & G CENTRIFUGAL PUMPS
A complete line for industrial application and refrigeration or air conditioning installations. Send for catalogs.

YOUR ANSWER TO FLEXIBLE TUBING PROBLEMS

PENFLEX "FLEXINEERING"

THE CORRECT TUBING . . . PLUS TECHNICAL AID ON EVERY JOB

is the *know-how* of the Penflex Engineer plus the *can-do* of Penflex Flexible Metallic Tubing serving you from design board right up to job installation and maintenance. It is the scientific application of the right type of steel, bronze, or aluminum flexible tubing to your air, oil, water, gas, steam, volatiles, or light solids conduction requirements. It is the specific recommendation of the right size and weight flexible tubing—four-wall interlocked or seamless welded corrugated type—in sizes from 1/8" to 24" I.D. And it is the nation-wide supply of Penflex in any quantity where you want it, when you want it.

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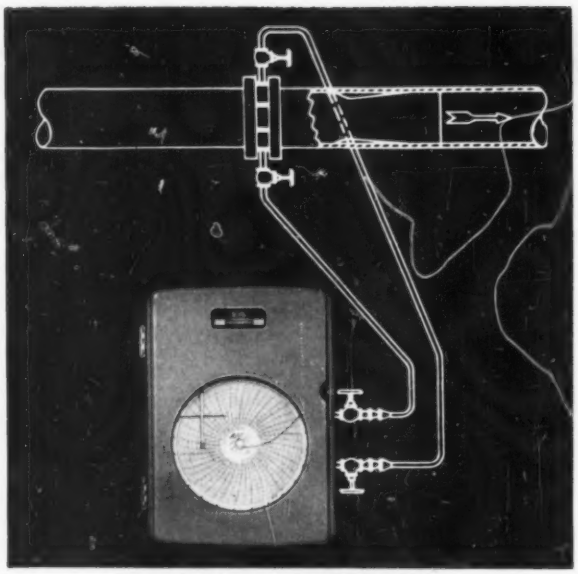
HEART OF INDUSTRY'S LIFE LINES



GOOD NEWS FOR METER USERS!

Builders now offers this adaptation of the famous Builders Flo-Watch — the new Model AFUAQ metering instrument. Basic simplification in the mercury wells and in the linkage between float and meter mechanism result in a meter of better-than-usual accuracy that's economical in first cost and maintenance. Also it is ideally suited to applications having a limited flow range, such as the metering of centrifugal pump discharge.

Model AFUAQ has all the important features of the Flo-Watch line — direct-reading graduations on 12" chart and 7-digit totalizer — shop tested with actual water differential — interchangeable range tube for adapting to altered conditions — attractive, durable dust-proof case for floor stand, panel, or wall mounting.

Model AFUAQ Flo-Watch is shown here in conjunction with Builders NZIF Venturi Insert Nozzle — a differential producer which combines the accuracy and low head loss characteristics of a Venturi tube with the compactness and economy of a conventional flow nozzle.

SEND COUPON FOR COMPLETE DETAILS

BUILDERS-PROVIDENCE, INC.

(DIVISION OF B-I-F INDUSTRIES)

354 Harris Avenue, Providence 1, Rhode Island

Please send Bulletins 300-J14 and 130-D7B describing Model AFUAQ Flo-Watch and Model NZIF Insert Nozzle.

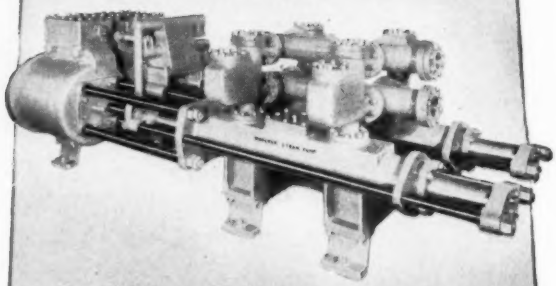
NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

"PALMETTO® 1000" rides the rods— without hardening



PROOF AGAIN THAT QUALITY PACKING PAYS

For WAGENER PUMP CO. of Canton, Ohio, the common pump problem of scored rods due to hardened packing just doesn't exist. In 45 years of using Palmetto 1000 Braided Square Packing on the steam and liquid rods of reciprocating pumps, Wagener has not had to consult on this problem. Savings for Wagener—Savings for Wagener customers!

PALMETTO 1000 is built up from high grade 12 cut white asbestos yarn—each strand saturated separately with a special lubricant before being twisted and braided into the finished packing. This thorough lubricating technique means maximum pliability under extreme temperature conditions — frictionless operation — score-free rods and shafts—long, uninterrupted service.

What worked for Wagener will work for you ..

Write in for details on Palmetto 1000 and other Palmetto Self-Lubricating Packings.

Our 90th Year — Nearly a Century of Quality

PALMETTO Packings

packing more performance into every application

GREENE, TWEED & CO. North Wales, Pa.

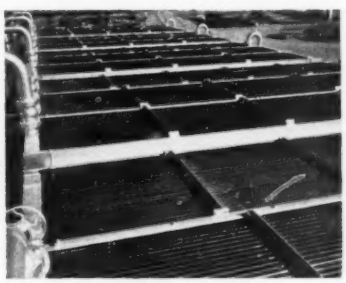
G-R fin-fan ...

from every point of view...

top value in **Air-Cooled Heat Exchangers**

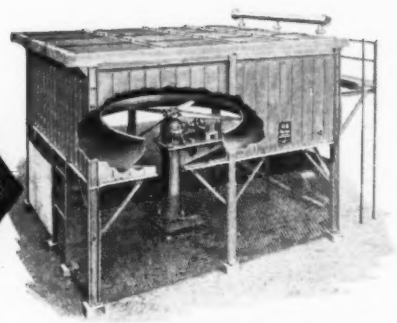
G-R **fin-fan** is top value in air-cooled heat exchangers because of the *experience* behind this unit. This experience includes 85 years of building heat transfer apparatus, 25 years of specializing on extended heat transfer surfaces as used in air-cooled exchangers, the operating records of hundreds of **fin-fan** installations all over the world, and the results of thorough tests on every element of the unit.

FROM ABOVE



The K-Fin Sections which form the heat transfer surface are used only in the G-R **fin-fan**. Many millions of square feet of this exclusive helically-finned surface are being used in more types of air-cooled services than any other design.

FROM THE SIDE



The strong reinforced construction is built to withstand wind pressures of more than 40 lbs. per sq. ft. The pre-fabricated, pre-drilled structure is specifically designed for speed and convenience of erection and connection to additional units.

FROM BELOW

Drive mechanism for G-R **fin-fan**. Note the mounting of driving motor and gear reducer, the powerful fan of proven performance, and the smooth bell ring for maximum aerodynamic efficiency.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR324A

BACK PRESSURE VALVES . . .

No. 135 illustrated — Klipfel Cup Disc back pressure and relief valve cuts size required to half that of other types. Very large capacity with closer, chatter-free regulation. Closes tight with minimum blow down. For maximum inlet pressures 80 to 300 lbs. according to size. Other types available. GET BULLETIN 648.

Call Your Supply House or See Classified Phone Directories for Nearest KLIPFEL Agent.

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K-910

Klipfel VALVES, INC.
HAMILTON, OHIO

ONE CONTROL DOES THE JOB OF TWO

DA-400

Available with Explosion-Proof or Weatherproof Housing

Mercoid DA-400 Series Pressure Controls incorporate a single bourdon tube which actuates two independently adjustable Mercoid magnet operated mercury switches to accomplish various circuit operations. For example:

1. Close one alarm circuit at high pressure and another at low pressure with both circuits open over operating range.
2. As an electrical interlock to open one circuit as pressure rises above and the second circuit as the pressure drops below operating range.
3. To provide two-stage control by opening or closing one circuit on a rise in pressure and the second circuit on a further rise in pressure.

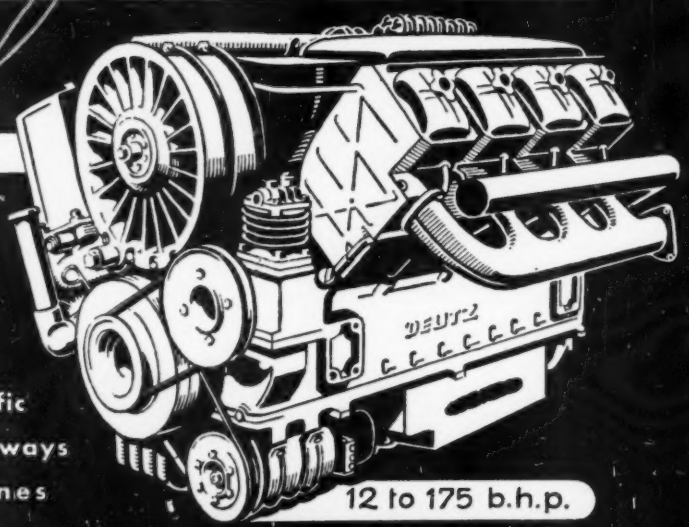
Equipped with calibrated dial and outside adjustments—Ranges 0-30 psi to 300-2500 psi—The Mercoid magnet operated mercury switches are not affected by harmful effects of dust, dirt, or corrosion—your assurance of millions of operations.

Write for Bulletin 5P

THE MERCOID CORPORATION
4201 BELMONT AVE., CHICAGO 41, ILLINOIS, U.S.A.

DEUTZ Diesel

air cooled



for
road and rail traffic
ships on all water-ways
working machines
for all applications

12 to 175 b.h.p.

KLÖCKNER-HUMBOLDT-DEUTZ AG · KÖLN
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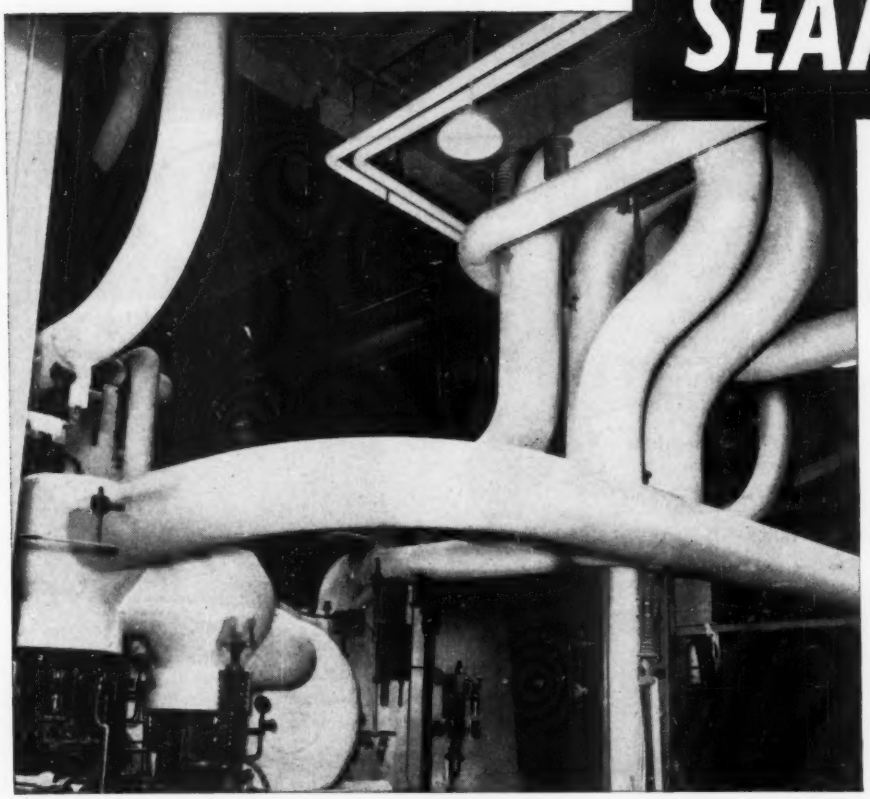
Play it Safe with NATIONAL SEAMLESS



● With pressures and temperatures constantly increasing, plant engineers everywhere are putting their complete confidence in U·S·S NATIONAL Seamless Pipe and Tubes. And for good reason. The life of a modern steam plant hinges on the dependability of its high pressure steam lines. And there is no more dependable power piping than NATIONAL Seamless —the famous "Walls Without Welds" that give you the extra margin of safety that only Seamless provides.

U·S·S NATIONAL Seamless has never been surpassed for power plant service, even under the severest operating conditions. Pierced from solid billets of steel, NATIONAL Seamless Pipe and Tubes have the strength, uniformity, and dependability of solid forgings. Each length is an homogeneous steel cylinder with uniform wall strength throughout. NATIONAL Seamless is designed to remain structurally sound under high temperatures and intense pressures.

If you're planning the building of a new plant or repiping a present installation, remember to "play it safe" and specify NATIONAL Seamless Pipe and Tubes for longer, safer, more dependable, more economical service.

Further information about NATIONAL Seamless Pipe and Tubes for power plants is offered in the following free booklets:

Bulletin Number 26 — concerns the properties of steels employed for elevated temperatures.

Bulletin Number 10 — technical data on high-pressure power plant piping.

Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S NATIONAL Seamless PIPE AND TUBES

USS

UNITED STATES STEEL

All working parts on COVER

of ADSCO DUAL STEAM TRAP

Only ADSCO's exclusive features make maintenance so easy. There's no breaking of pipe connections to inspect or service the trap, because all working parts are mounted on the cover. An extra cover assembly becomes a complete spare trap . . . replace the cover in a matter of minutes, service the original, and the result is a spare trap always ready.

ADSCO traps offer additional exclusive advantages: reversible stainless steel valve and seat double the life of the trap . . . inlet and outlet connections on *both* sides make installation easy and less expensive. Write today for catalog data.

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877

WPS Engineering Department—quality begins here . . .

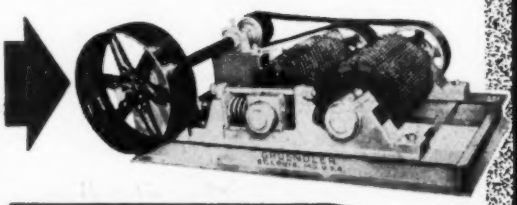
TEAMWORK PRODUCES BETTER PIPING

Western Piping Supply gives customers fabricated piping of superior quality because every job is a team job. Design engineers, draftsmen and foremen work together . . . laying out each job to provide flexibility and simplicity, at lowest possible total cost.

You'll get these benefits, too, when you specify WPS.

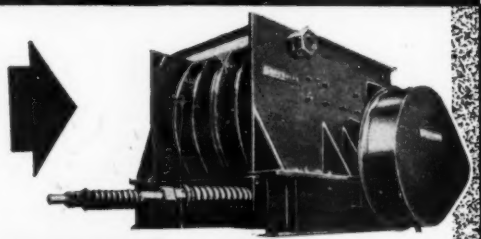
WESTERN PIPING SUPPLY DIVISION
THE LUMMUS COMPANY
504 WEST 145TH STREET, EAST CHICAGO, INDIANA
Representatives in Major Cities
FABRICATORS OF CARBON AND ALLOY PIPING

GRUENDLER



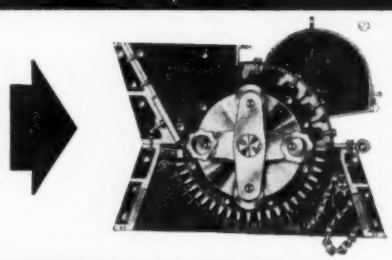
Double Roll Crusher (hopper and cover removed to show cone type teeth). For domestic secondary crushing in the 1" to ⅜" range. Produces minimum fines and dust.

COAL CRUSHERS



Single Roll Crusher. Heavy duty, roller bearing constructions. For ROM and strip mine coal and as preparation for further reduction and gradation.

FOR ECONOMICAL CRUSHING



Ring Hammermill. Large capacity and great uniformity. For ROM or secondary crushing of lump, egg, and stoker sizes.

A CRUSHER FOR MOST EVERY COAL CRUSHING PROBLEM—WRITE FOR INFORMATION, NO OBLIGATION

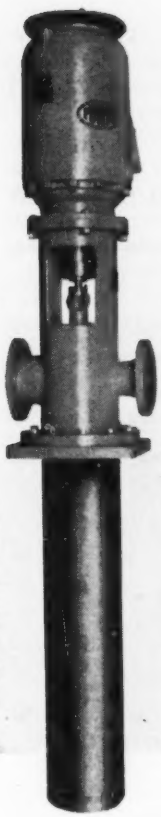
GRUENDLER CRUSHER & PULVERIZER CO.
2915 N. MARKET ST. • ST. LOUIS 6, MO.

FOR *ALL* *your* **PUMPING problems:**

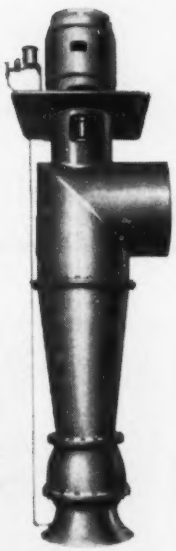
- HOT OR COLD WATER CIRCULATING
- LOW PRESSURE WATER HANDLING
- HIGH PRESSURE PUMPING
- BOOSTER PRESSURE SYSTEMS
- WATER SUPPLY AND TRANSFER
- LARGE VOLUME LOW HEAD PUMPING
- CHEMICAL PROCESS SERVICE PUMPS

YOU CAN DO A BETTER JOB with these *Dependable* PEERLESS PUMPS

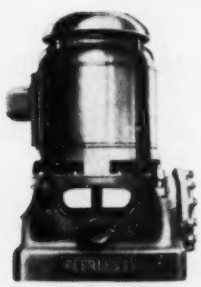
VERTICAL HORIZONTAL



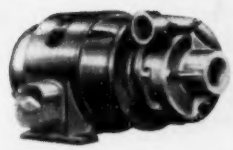
VERTICAL ENCASED CENTRIFUGAL PUMP—The Peerless "Hydro-Line." For heavy duty condensate return service. Rugged, dependable, versatile, vertical design.



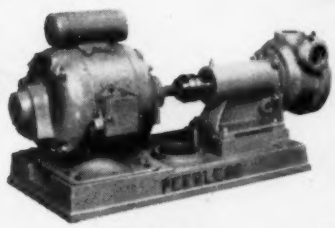
MIXED FLOW AND PROPELLER PUMPS—Giants in the world of pumping. For high capacities, low head. Single and multi-stage types for all water services. Also widely applied to flood control and drainage pumping. Capacities to 220,000 gpm.



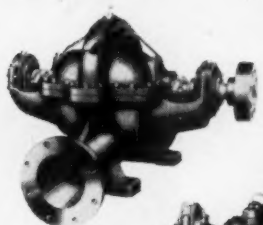
VERTICAL TURBINE TYPE PUMPS—Electric and engine driven pumps for primary water supply from deep or shallow drilled wells. America's sales leader. All sizes, capacities and hp.



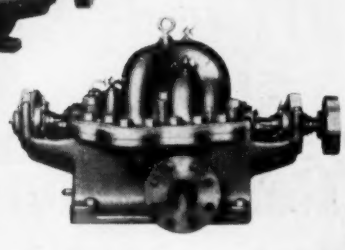
END SUCTION PUMPS—The Peerless "Fluidyne" line. Economical face mount and flexible coupled pumps for widest variety of water handling services. ¼ to 150 hp available. Efficient, easily serviced.



TURBINE VANE TYPE PUMPS—For pumping hot or cold, clear or vaporous liquids. Face mount or flexible coupled types. Standard and self-priming models for pumping small capacities, high heads.



TYPE A—ALL PURPOSE WATER PUMP—Single stage double suction split case type pumps. Broad line, up to 70,000 gpm capacity. All types of drive; quality construction.



TYPE TU—MULTI-STAGE PUMP—For high pressure pumping. 2, 3, 4 and 5-stage pumps available. Horizontal split case design. For capacities up to 3500 gpm; heads to 1600 feet.

PEERLESS PUMP

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

PEERLESS PUMP DIVISION

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Factories: Los Angeles, Calif. and Indianapolis, Indiana.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis; Phoenix; Fresno; Los Angeles; Tulsa; Dallas, Plainview, and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory.

Mail Coupon TODAY!

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301 West Avenue 26, Los Angeles 31, California

CHECK BULLETINS YOU REQUIRE

- ☐ TURBINE VANE PUMPS — Bulletin B-2205
- ☐ VERTICAL ENCASED HYDROLINE PUMP — Bulletin B-592
- ☐ MULTI-STAGE PUMPS — Bulletin B-1400
- ☐ FLUIDYNE END SUCTION PUMPS — Bulletin B-2300
- ☐ TYPE A ALL PURPOSE PUMP — Bulletin B-1300
- ☐ WATER SUPPLY PUMPS — Bulletin B-141

NAME_____

COMPANY_____

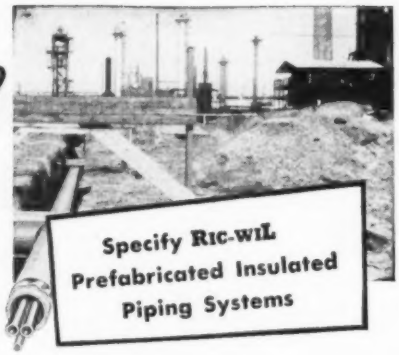
STREET_____

CITY_____ STATE_____

POW.

Piping Problems?

For Fast Economical Installation and Longer Service Life...



Specify RIC-WIL Prefabricated Insulated Piping Systems

Fast Economical Installation — Ric-wiL systems are prefabricated under ideal factory conditions leaving a minimum of work to be done in the field. Ric-wiL engineering service provides complete technical data and detailed working drawings — assuring rapid and accurate installation.

Longer Service Life — Ric-wiL systems are factory prefabricated on precision machines — all operations are carefully controlled eliminating chances for faulty workmanship to cause service failure.

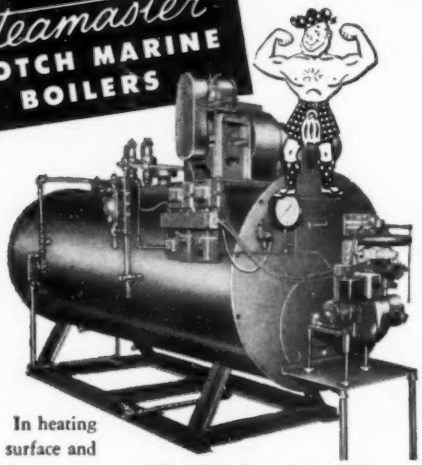
Whether your problem involves underground or overhead piping — extreme temperatures or corrosive products — if proven insulated piping systems are required . . . it will pay you to call in your Ric-wiL representative as early as possible in your planning.

Ric-wiL PREFABRICATED INSULATED PIPING

UNDERGROUND OR OVERHEAD

THE RIC-WIL COMPANY • BARBERTON, OHIO

Steamaster SCOTCH MARINE BOILERS



In heating surface and service, you get more for your money... an exceptional 7 to 8 sq. ft. heating surface per boiler hp.

- Ten sizes from 3 to 150 hp
- Passes any insurance inspection
- No lagging or brickwork
- Gas, oil or combination firing
- Natural or induced draft
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- Submerged tubes last longer

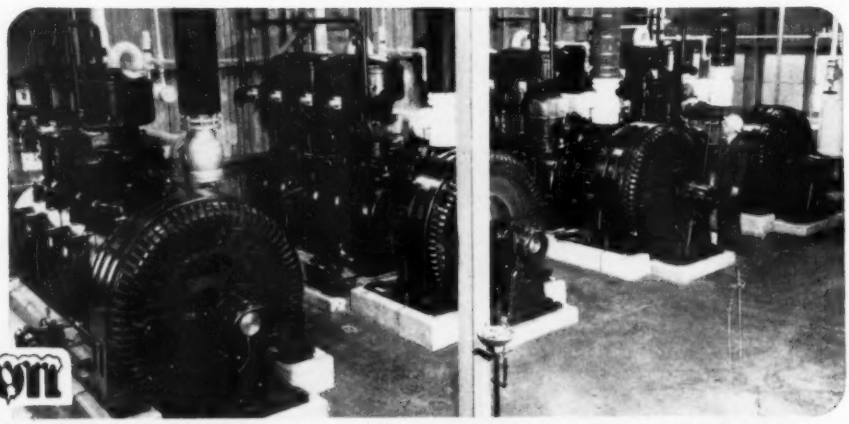
Write, wire or phone today for a personal survey of your boiler needs.

STEAMASTER AUTOMATIC BOILER CO.

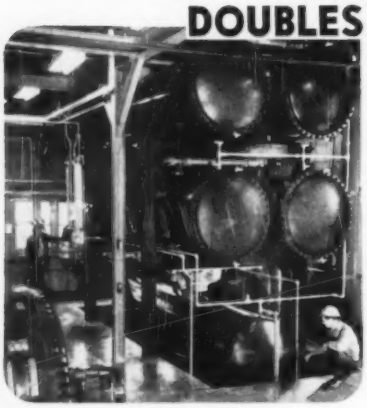
5819 Compton Ave., Los Angeles 11, California • LUcas 6226

TRADE FRICK MARK®

Refrigeration



DOUBLES PRODUCTION OF RUBBER REACTORS



Synthetic rubber plants all over this country, and in Canada, are finding Frick special coils and controls the answer to the problem of cooling reactors. Vertical pipes flooded with ammonia, inside the reactors, replace sluggish brine jackets with trigger-fast cooling. This exclusive Frick development cuts reactor time in half—an unbelievable achievement!

What is YOUR cooling problem? Whether for process work, research, air conditioning, cold storage, or quick freezing, there's a Frick refrigerating system to suit your needs. Let us submit estimates now on your requirements. Branches and Distributors in principal cities: write, wire, phone or visit

Photos show Frick Ammonia Compressors, with 600-hp. motors; Frick Condensers, Receivers and Purger at Kentucky Synthetic Rubber Corp., Louisville, Ky.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

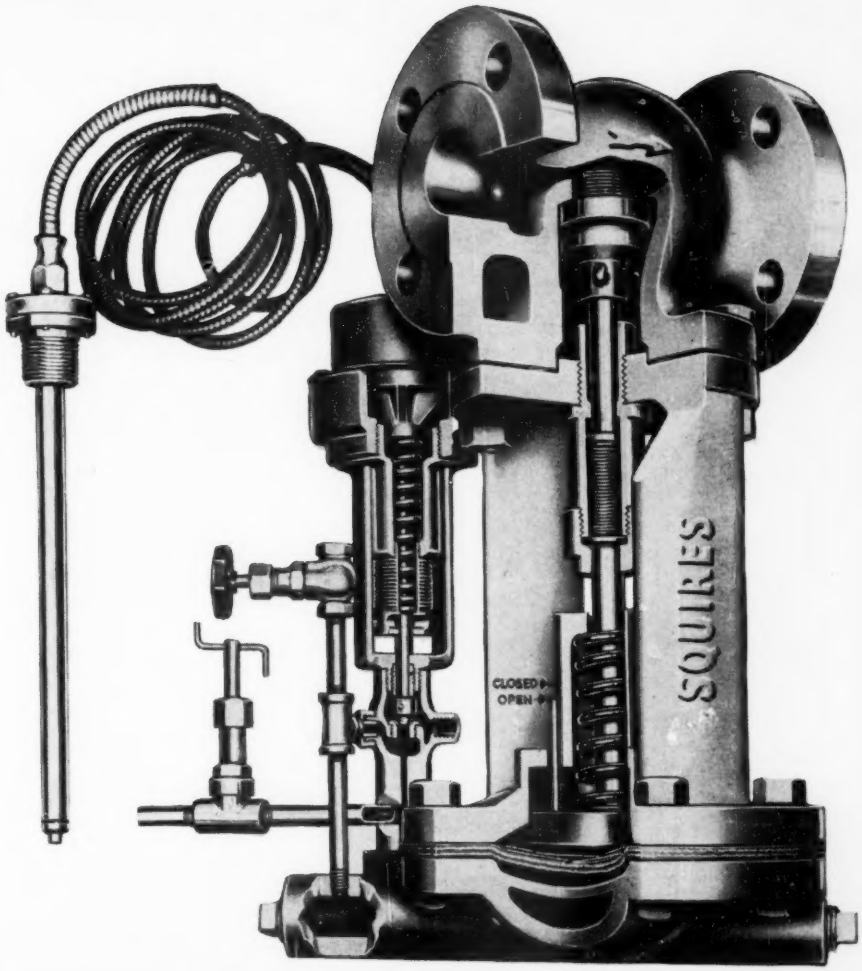
Also Builders of Power Farming and Sawmill Machinery

POSITIVE DEAD END

SINGLE SEATED

OUTSIDE PILOT

PATENTED
DIAPHRAGM



SQUIRES TEMPERATURE REGULATOR

One Degree Temperature Control

Pilot operated Squires Temperature Regulators give positive dead end service. Among their many applications are hot water heaters, chemical processing, pickling tanks, dye vats and vessels where one degree temperature or more must be held.

Available in sizes ½" through 12", temperature ranges 40 or 60 degrees, maximum 600 psig. Standard bulb trim, brass with 8 ft. capillary tubing, can furnish longer lengths or stainless on request.

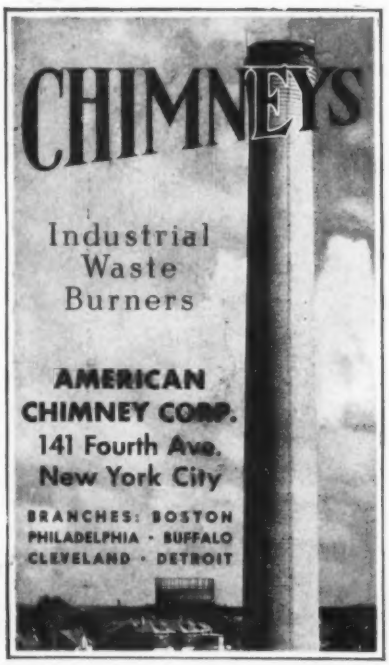
THE C. E. SQUIRES COMPANY

Over 50 Years of Dependability

18502 SYRACUSE AVENUE • CLEVELAND 10, OHIO

WHERE TO BUY

Featuring additional products, specialties & services for power plants



GAGE GLASSES AND
High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

NEW TUBULAR SCAFFOLD
GOES UP and DISMANTLES EASIER FASTER — STORES COMPACTLY

Complete flexibility as to size and shape. Can be fabricated to fit your needs—rolling, dolly, fixed, chain hoist, etc.

HARDIE CLAMP SCAFFOLDING
519 Atlantic Ave., Brooklyn 17, N. Y.

STOP *that* WATER

With FORMULA NO. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. $3 in 55's. Free sample. See Sweet's.
HAYNES PRODUCTS CO., OMAHA 3, NEBR.

A Good Habit

This Where To Buy Section supplements other advertising in this issue with additional announcements of products and materials of special interest and application in the power generation and transmission field. Make a habit of checking this page each issue.

PROFESSIONAL SERVICES

AMERICAN HYDROTHERM CORP.
Thermo Engineers
HIGH TEMPERATURE WATER SYSTEMS FOR DISTRICT AND INDUSTRIAL HEATING
Universities, Hospitals, Military Bases, Housing Projects; Plant Process and Space Heating; also Power Generating Plants with Heat Distribution Requirements.
33-70 12th Street, Long Island City 6, New York

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. Chicago 4

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
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SANDERSON & PORTER
Engineers and Constructors
New York • Chicago • San Francisco

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City, Mo. P. O. Box 7088
Cleveland, Ohio 1404 E. 9th St.

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

GILBERT ASSOCIATES, INC.
Engineers • Consultants • Constructors
Reading, Pa.
Engineering and Design • Construction Supervision
Industrial • Sanitary • Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing
New York Philadelphia Washington
Rome Manila Medellin

J. E. SIRRINE COMPANY
Engineers
Power Plants Consultations
Design Reports
Water Steam Utilization Plants
Greenville South Carolina

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

STANLEY ENGINEERING COMPANY
CONSULTING ENGINEERS
Power Plants
Steam — Diesel — Hydro
Design — Construction — Test — Valuation
Hershey Building Muscatine, Ia.

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
Power Plant Specialists
Utility — Industrial — Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SYSKA & HENNESSY, INC.
Engineers
Consultation Plans Reports
Power Plants Disposal Plants
Water Systems
114 East 39th Street
New York, New York

PETER F. LOFTUS CORPORATION
Engineering and Architectural Consultants and Designers
First National Bank Bldg.
Pittsburgh 22, Pennsylvania
Cable Address—"LOFTUS Pittsburgh"

WATER SERVICE LABORATORIES, INC.
Specializing Since 1927
Water Treatment for corrosion control in buildings, boilers and air conditioning systems.
New York—Philadelphia—Washington, D. C.

LUTZ AND MAY
Consulting Engineers
STEAM, GAS & DIESEL POWER STATIONS
PUMPING PLANTS—ELECTRIC SYSTEMS
REPORTS—DESIGN—APPRAISALS
100 Baltimore Kansas City 6, Mo.

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

PEARSON and GUSSOW
Consulting Engineers
1231-38 Majestic Bldg. Detroit 26, Mich.
Woodward 5-0188

WHEN TIME IS SHORT . . .
put the solution of your problems up to a specialized Consultant whose professional card appears on this page. His broad experience may save you months of costly experimentation.

POWER
330 West 42nd St., New York 36, N. Y.

Con Edison specifies "K" Monel pump shafts for New Astoria Station

At their first all-new plant in 25 years, the Consolidated Edison Company means to take no chances with pump shaft trouble.

The Astoria Station, now under construction at the edge of New York's East River, has four single-stage vertical mixed flow pumps (each with a capacity of 68,500 gpm) to circulate water for its condensers. Made by Economy Pump Division of H. C. Wheeler Manufacturing Company, *all four pumps have "K" Monel shafts, as specified by Con Edison engineers.*

They singled out this rugged shafting material for several important reasons. For one thing, they knew "K" Monel offered them excellent resistance to corrosion. This was a basic need, for water drawn from the brackish, sewage-polluted East River is highly corrosive.

They wanted, too, a shaft metal that had great strength and hardness, and high resistance to corrosion fatigue.

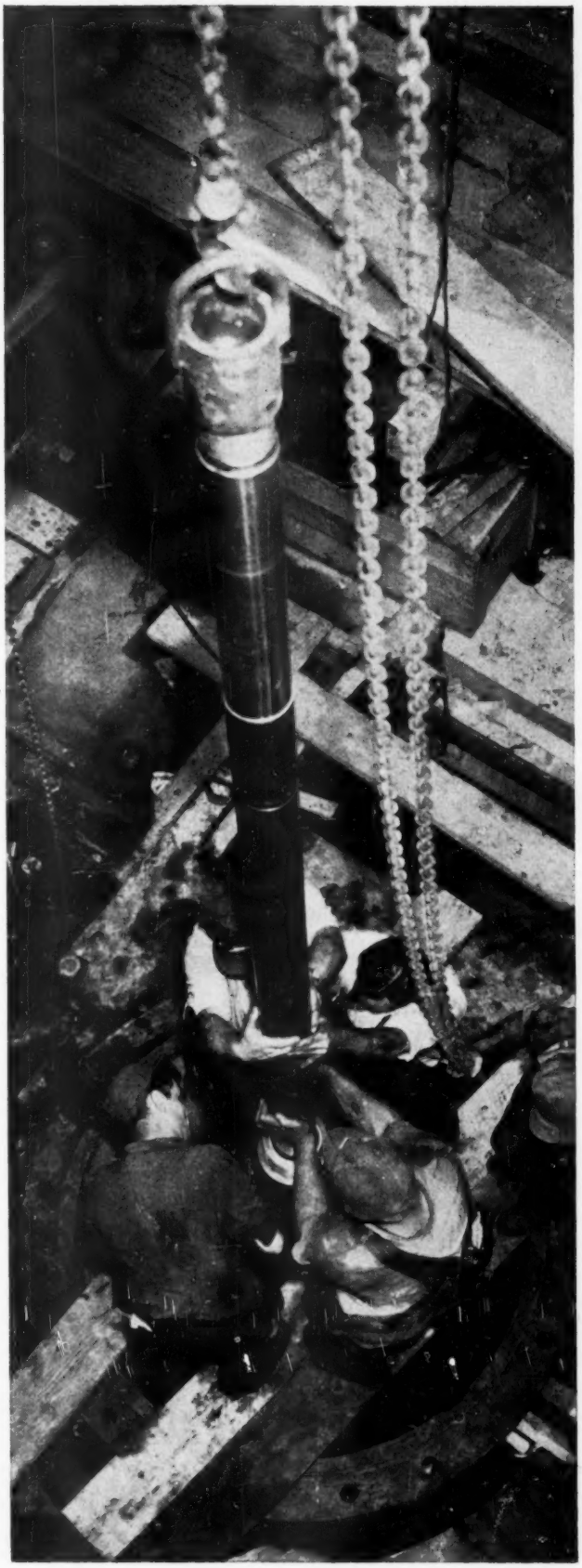
"K" Monel meets all these requirements. And it has the additional advantage of being heat-treatable *after* machining without undue distortion.

There's valuable information for pump users in our booklet, "*How to get longer service from your pumps.*" A copy belongs on the desk of every man concerned with the operation, maintenance or purchase of pumping equipment. The booklet will be sent promptly — without cost or obligation. Write for it — *today.*

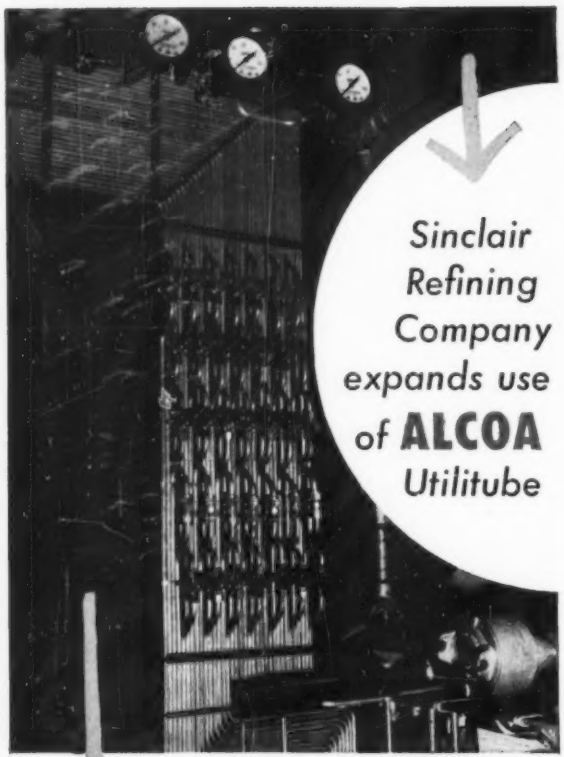
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys INCO

MONEL® • "R"® MONEL • "K"® MONEL "KR"® MONEL • "S"® MONEL • INCONEL® INCONEL "X"® • INCONEL "W"® • INCOLOY® NIMONIC® Alloys • NICKEL • LOW CARBON NICKEL DURANICKEL®



One of four. Workmen lower a "K" Monel shaft into a giant SAFV Wheeler-Economy pump at Con Edison's new station in Astoria, N. Y. This shaft is 6 inches in diameter, 27½ feet long, and weighs 1,900 pounds. It has a minimum Brinell hardness of 265. In operation, the pump, with a total dynamic head of 16 feet, will be driven at 233 rpm by a 400-hp motor.



Sinclair Refining Company expands use of **ALCOA** *Utilitube*

ALCOA Utilitube* serves air to control board instruments at Sinclair's Light Oil Treating Plant, Houston, Texas. Satisfactory operation of two other Alcoa Aluminum Coiled Tube installations prompted this new installation.

USE ALCOA UTILITUBE for fuel and lube lines, for hydraulic fluids, for air and refrigerants. It will not gum or sludge in petroleum service, nor will it discolor or contaminate the fluid it carries.

USE ALCOA UTILITUBE TO SAVE MONEY. It's the lowest cost corrosion-resistant metal tube you can buy . . . may very easily cut your tube costs by 40 per cent!

ALCOA UTILITUBE forms, flares and bends as easy as annealed copper yet work hardens less. At sub-zero temperatures it actually gets stronger!

ALCOA UTILITUBE AND FITTINGS are available from your aluminum distributor. For complete information, write for the booklet: "Alcoa Utilitube."

ALUMINUM COMPANY OF AMERICA
1004-M Alcoa Building, Pittsburgh 19, Pa.

*Registered Trademark, Aluminum Co. of America

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

to the power plant man

who wants to be

A SALES ENGINEER!

Some of our most successful Sales Engineers served their apprenticeships in power plants. They found—and so did we—that this practical background ideally suited them to be trained for better-paying, permanent sales jobs.

The men who qualify will be thoroughly trained to replace men in established territories who have been promoted. They'll be paid salary, commission and expenses...will participate in our profit-sharing, group insurance and sick benefit programs.

If you're in your thirties...know boiler operation, write or phone Mr. W. H. Bingham for a confidential interview.

Dearborn

TRADE MARK

DEARBORN CHEMICAL COMPANY, Merchandise Mart Plaza, Chicago 54, Ill.
Phone: WHitehall 4-3273

For complete data on power-field information, in its handiest and most economical form, write today for

Power's "Reprint Folder"

Giving summaries on the best condensed handbooks available

POWER, 330 W. 42 St.
New York 36, N. Y.

Gentlemen: Please send me a copy of POWER's "Reprint Folder."

Name .....

Address .....

City and State .....

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

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UNDISPLAYED RATE
$1.50 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (See ¶ on Box Numbers.)
POSITION WANTED and Individual Selling Opportunity Wanted undisplayed rate is one-half of above rate, payable in advance.
PROPOSALS, $1.50 cents a line an insertion.

INFORMATION
BOX NUMBERS count one additional line in undisplayed ads.
DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).
EQUIPMENT WANTED or FOR SALE Advertisements acceptable only in Displayed Style.

DISPLAYED RATE
The advertising rate is $16.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches —to a page.
PR.

NEW ADVERTISEMENTS, N.Y. Office, 330 W. 42nd St., N. Y., for the January issue closing December 8th

SHIFT SUPERVISORS
TUCSON, ARIZONA

Three shift supervisors to assume complete responsibility for plant during shift. Plant consists of 2—100,000 KW units 1450 psig 1000° centralized control. Primary fuel, gas; secondary fuel, oil. Location 30 miles North of Tucson. Compensation for travel expense.

ARIZONA PUBLIC SERVICE CO.
P.O. Box 2591, Phoenix, Arizona

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

(Additional Positions Vacant Advertising on the following page)

WANTED: MECHANICAL engineer, age 20-35, as assistant to mechanical engineer of new 938,000 KW Steam Power Station. Experience in power plant testing and instrumentation desirable. Degree essential. Address replies to: J. G. Koopman, Electric Energy, Inc., Box 165, Joppa, Illinois.

WANTED: SERVICE Engineer. Mechanical Engineer experienced in starting up and testing large power boilers, including reheat, fired by stokers, pulverizers, or oil and gas burners. Must be personable and willing to travel. Please send complete details education and experience background in first letter. P-9624, Power.

SELLING OPPORTUNITY OFFERED

SALES ENGINEERS, with a knowledge of steam boiler operation and maintenance and experienced in selling to the industrial heating and power plant trade, are wanted for permanent positions in choice territories in various states. Assignment as a direct factory representative involves the sale of a combustion type boiler fireside cleaner, a triple action fuel oil conditioner, and smoke control equipment to commercial and industrial plants. High income arrangement on initial and repeat orders assures good substantial year 'round earnings. Address applications to KOR Division, Dept. GW, P.O. Box 485, Gary, Indiana.

EMPLOYMENT SERVICE

SALARIED PERSONNEL. $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

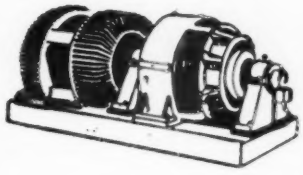
POSITIONS WANTED

POWER ENGINEER seeking position as supervisor of moderate size steam power plant. Age 30, 8 years experience (3 years as supervisor) operation and maintenance of power plant and air conditioning equipment. Will consider job as operator which could lead to supervisory position. PW-8728, Power.

WANTED—PERMANENT work by experienced power house operator. High pressure steam turbines, boilers and diesel, best of reference. PW-9368, Power.

Continued on the following page

SEARCHLIGHT EQUIPMENT SPOTTING SERVICE



This service is aimed at helping you, the reader of POWER, locate used and surplus new power equipment not currently advertised (this service is for user-buyers only).

First, read the dealer ads on the following pages. A 5-minute study may locate the equipment *now*.

Second, send in the specifications of the equipment wanted on the coupon below, or on your own company letterhead, to

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., N.Y. 36, N.Y.

Your requirements will be brought promptly to the attention of the used equipment dealers advertising in this issue. You will receive replies directly from them.

NO CHARGE • NO OBLIGATION

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., New York 36, N. Y.

Please help us locate the following used equipment:

.....

.....

.....

.....

NAME ..... TITLE .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

12/53

WANTED

Assistant Chief Engineer

Graduate Mechanical, Chemical or Civil Engineer with natural mechanical ability and excellent practical and supervisory and some construction experience for charge, under chief engineer, of all shops, foundry, mobile equipment, including loading, marine, railway and construction; maintenance and repair of all types equipment; 3500 KVA diesel generating plant.

Age not over 45. Three year contract with three months' paid vacation at completion contract and two 1-week local leaves after first year. Furnished house and partial utilities supplied free. Free transportation self and family. Hospital, medical and elementary schooling free. Non contributory pension plan. Report single status six months. Require complete record, education, employment and references; also marital status and nationality. Photograph optional. Location — Mediterranean. Large copper mine. Salary open.

P-9799, POWER
1111 Wilshire Blvd.
Los Angeles 17, Calif.

ELECTRICAL INSPECTORS WANTED

By the Tennessee Valley Authority for inspection of major electrical equipment and materials at manufacturing plants located in cities such as Philadelphia, Pittsburgh, Schenectady, and Milwaukee.

Work includes inspection of material and equipment during all stages of manufacture, witnessing factory tests, conferring with shop officials, and preparing necessary inspection and test reports. Some of the materials and equipment involved are generators, transformers, oil-circuit breakers, communication equipment, switches, insulators, and wire.

Persons with factory experience on inspection of electrical equipment and materials used in construction of hydro and steam electric generating plants are desired.

Entrance salaries are $4575 and $5450 a year for 40 hour week. Vacation, sick leave, and retirement benefits. *Write to the*

TENNESSEE VALLEY AUTHORITY
Division of Personnel, Knoxville, Tennessee

ATTENTION RETIRED POWER ENGINEERS

A well known company in the Philadelphia area is building a large addition to an existing high pressure steam-electric generating plant, and is interested in obtaining, on a temporary basis of approximately twelve months, several high caliber power plant operating engineers and one chief electrician; who have been retired because of age but are still physically fit. The work will be as inspectors during construction, representing the client in checking the installation of high pressure boilers, turbine generators, auxiliaries, piping and electrical equipment.

Applicants must have extensive operating experience on high pressure modern power plants as Power Plant Superintendents, Assistant Superintendents, Chief Engineers or Chief Electricians. Only qualified operating engineers living in the Philadelphia area or within commuting distance of the job will be considered.

Please submit detailed outline of past experience, jobs held, salaries received, and statement of age and physical ability. Include recent photo or snapshot if available. Do not apply unless your experience meets the requirements as outlined above.

P-9603, POWER
330 W. 42nd St., New York 36, N. Y.

(Continued from preceding page)

EXPERIENCED SWITCHBOARD Operator would like operating job in central or substation. PW-9867, Electrical World.

ENGINEER: CHIEF—Plant—Maintenance graduate—several years heavy experience. Steam and electrical generation and distribution—refrigerating and air-conditioning etc. General plant Master Mechanic. Utility or Industrial. Domestic or Foreign. "Engineer 331 W. Marguette Road, Chicago 21, Illinois.

STEAM PLANT Operating Engineer. Age 43. 10 years experience Modern steam plant operation. PW-9590, Power.

MASTER MECHANIC, 45, 20 years exp. installing, operating, servicings power plant and industrial equipment. Responsible for permanent position in modern power plant. PW-9816, Power.

SELLING OPPORTUNITIES WANTED

ESTABLISHED FIRM mechanical sales engineers, covering Southeastern States past 35 years, seeking additional products to sell power plants, water works, industrials, chemical plants, paper mills. Reply SA-9524, Power.

EXPERIENCED SALES Engineers available. Engineering sales contacts frequently made for you on Southeastern trade by widely known mechanical graduates successfully operating. Our experience shows that calls make sales. RA-9724, Power.

RELATED ACCOUNTS wanted—valves, pipe fittings, pumps, packaged boilers, steam specialties, pressure or temperature instruments, power plant equipment, process piping products. Registered Mechanical Engineer organizing sales agency Southern California. Offer background of succe sful selling with excellent contacts oil companies, industrials. RA-9865, Power.

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Safety valve set 100 lbs.

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2—steam boilers, approx. 350 H.P. each
1—steam-turbo generator, approx. 1000 H.P.
Above for use in lumber plant

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4000-5000 Kw. 3600 RPM generator preferably 2400 V; De-aerating feed water heater; 7.5 Indoor O. C. Breakers 100 MKVA Interrupting capacity.

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1000 to 1500 HP, 300 RPM, for 4160 volt, 3 phase, 60 cycle, AC. When offering, include complete nameplate data including serial numbers. Write

W-9545, POWER
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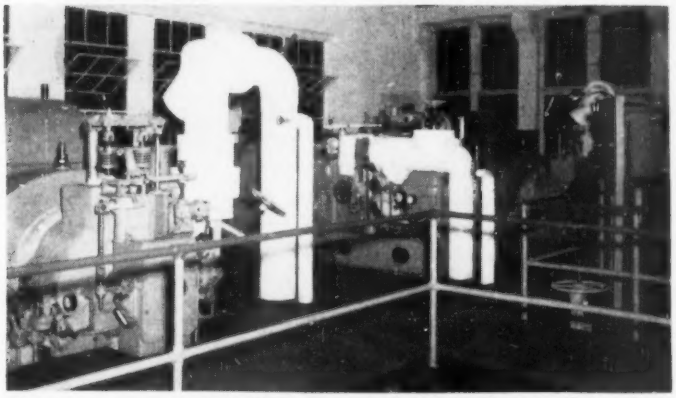
2250 K.V.A. G.E. CONDENSING TURBINE GENERATOR



Above cut shows our 2250 KVA. General Electric Condensing Marine Type Turbine Generator. A Complete Machine with Condenser.

A HIGH EFFICIENCY UNIT
440# PSIG., 750° F.T.T.
CONDITION LIKE A NEW UNIT

SPECIFICATIONS

TURBINE

Manufacturer	General Electric
Capacity	2250 KVA Type FSN
Speed	3600 RPM
Steam Pressure	440# psig., 750°FTT
Exhaust Pressure	2-in. Abs. H.G.
Serial Number	62794

GENERATOR

Manufacturer	General Electric
Capacity	2250 KVA. Unity PF
Speed	3600 RPM
Voltage	3/60/480 Will rewind for any standard voltage
Exciter	110 Volts
Serial Number	5679091

WATER RATES 440 psig., 750° F., 3600 RPM

Full Load	2250 KVA	10.9 KWHR.
1125 Load	50% Load	12.0 KWHR.
1687 Load	75% Load	11.0 KWHR.

CONDENSER

Surface Type Capacity—3600 sq. ft.

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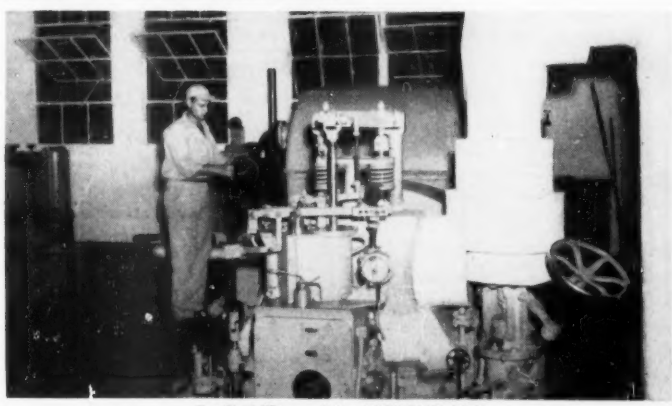

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45th Year of Service—Member of A.R.A. and N.I.S.A.

A. C. MOTORS

3 ph. 60 Cycle

SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1	—4350	Cr. Wh.		4160/13800	514
2	—3500	G. E.	TS	2300	257
1	—2500	G. E.	ATI	2300	720
2	—2100	G. E.	ATI	2300	360
2	—2000	Whse.		2300	120
1	—2000	G. E.	ATI	2200	900
2	—1750	G. E.	ATI	2300	3600
3	— 735	G. E.	ATI	2200/12000	600
1	— 500	Ideal	SM	2300/4150	1800
1	— 450	Whse.	Eng.	2200	128.5
1	— 450	Whse.		2300	450
1	— 400	G. E.	TS-6424	2200	400
2	— 350	G. E.	TS	2200	150
1	— 300	Whse.		2300	720
1	— 150	Whse.		440	60

SLIP RING

1—1500	G. E.	MT-498	2300	360
1—1500	ABB		2300	720
1—1200	G. E.	MT-26	2300	275
2—1000	A. C.	Mill	2300	240
1—1000	G. E.	MT-452	2200	321
1— 500	Whse.	CW	550	360
1— 500	G. E.	M-574Y	2200	900
1— 450	G. E.	IM	440	720
1— 400	Whse.	CW-1218	2200	435
1— 400	Whse.	CW	440	514
1— 350	G. E.	MT-412	2300/4000	253
1— 350	G. E.	IM-17A	440/2300	720
1— 250	G. E.	MT-424Y	4000	250
1— 250	G. E.	MT-559S	2200	1750
1— 250	A. C.		550	600
1— 200	Cr. Wh.	26QB	440	505
1— 200	G. E.	IM	440	435
1— 200	G. E.	MTP	440	1170
1— 150 new	Whse.	CW	2300	450
1— 150	G. E.	IM-16	440	600
2— 125	A. C.		440	865
1— 125	A. C.		440	720
4— 125	G. E.	MT-566Y	440/2200	435
2— 100	G. E.	IM	440	600
1— 100	G. E.	IM	2200	435
4— 100	A. C.		440	695
4— 100	G. E.	MT	440/2200	435

SQUIRREL CAGE

2— 650	G. E.	FT559BY	440	3750
2— 450	Whse.	CS	2300/4150	354
1— 200	G. E.	IK-17	440	1800
3— 200	G. E.	KT-557	440	1800
1— 75/150	G. E.	IK	440	450/900
1— 150	Whse.	CS	440	580
1— 150	Wstghse.	CS8568	440	880
1— 125	Whse.	MS	440	485
2— 125	Al. Ch.	ARW	2200	1750
2— 100	G. E.	IK	440	580
1— 100	G. E.	IK-Vert.	2200	450

D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1—2200		G. E.	MCF	600	360/500
1—2000		Whse.	Mill	600	230/460
1— 940		Whse.	QM R Brg.	250	140/170
1— 900		Whse.		250	450/550
1— 825		Whse.	Mill	250	90/180
1— 600		A. Ch.	Mill	230	400/800
1— 500		Whse.	Mill	600	300/900
2— 450		Whse.		550	415
1— 400		G. E.	MCF	550	300/1050
1— 300/400		G. E.	DYNA	250	1323/2500
1— 300		Whse.	CB-5094	230	575/1150
1— 200/300		G. E.	MPC	230	360/920
1— 250		G. E.	MPC	230	400/500
1— 200		Rel.	1970T	230	720
1— 200		Whse.	CB-5113	230	400/800
1— 150		G. E.		600	250/750
8— 150		Cr. Wh.	83H	230	890
1— 150		Cr. Wh.	CMC-65H	230	1150
1— 150		Whse.	SK-201	230	360/950
1— 150		Whse.	SK-151 B	230	900/1800
1— 125	(new)	Whse.	SK-183	230	850
1— 125		G. E.	MD8-416	230	415
1— 75		C. W.	53H-TEFC	230	860
1— 75		Whse.	SK-170	230	600/1200
1— 50/120		G. E.	MFC	230	250/1000
2— 100		Whse.	SK-181	230	450/1000
4— 60		El. Dy.	25-8	230	525/1050
2— 50/60		Whse.	SK-170	230	400/1200
1— 50		G. E.	CO-1810	230	725
1— 50		Whse.	SK-170	230	350/1050
1— 50		G. E.	RCP-31B	230	1700
2— 40/50		G. E.	CD-135	230	300/1200

MOTOR GENERATOR SET

3 Ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	3000 (3U)	G. E.	514	600	4000/13200
1	2000	G. E.	514	600	13800/4000
2	2000	G. E.	450	250	2400
1	2000 (25 cy)	G. E.	500	660	6600/11000
2	1750	G. E.	514	250	2400
1	1500	G. E.	720	600	6600/13200
1	1500	C. W.	514	115	4160/13800
2	1000	Whse.	900	600	2300/4100
1	1000	G. E.	900	260	6600
1	1000 (3U	G. E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4160
1	750	C. W.	514	115	2300
1	600	G. E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	1200	125/250	2300
1	500	G. E.	720	125	2300/4000
1	400	G. E.	720	250	440/2300
1	150	G. E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140 (3U)	Cr. Wh.	690	125-250	2 300
1	125	G. E.	1200	125	440
1	100	Delco	1200	125/250	440
1	100	G. E.	1200	250	2300/4000

12,500 KW 60 to 25 CYCLE FREQUENCY CHANGER—IMMEDIATE SHIPMENT

Westinghouse 300 R.P.M. 4 Bearing frequency changer set. Motor 17200 H.P. .7 P.F., 13200 Volt, 3 ph., 60 cy., Generator 13900 K.V.A., 12500 KW .9 P.F. 13200 volt, 3 phase, 25 cycles, with 2 direct connected 125 volt exciters, complete including motor operated phase shifter, air washer; 60 and 25 cycle controls—Prints, performance guarantees and complete details available—Can be inspected in operation.

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—	3000	G. E.	25/60	4000/2300x2300/4000
1—	2500	G. E.	25/60	2400x4150
1—	2000	G. E.	25/62½	2300/4160
1—	2000	Whse.	25/62½	2300/2300
1—	1000	G. E.	25/58	4400/2300
1—	500	A. C.	25/60	11000/2300V

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	Moore	Auto - Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G. E.	Condensing 425#-725°TT I.S.P. 440V. 3 ph. 60 cy.—New—1944
1	750	Whse.	—Non-condensing 135# I.S.P. 40# B.P. 750 Kw. 280 V. D.C.
1	500	Moore	Non-condensing—150/200 lbs. I.S.P. 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter.
2	500	G. E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P. 480/3/60
1	300	G. E.	Non-condensing 10/175# I.S.P. 5/15# B.P. 480V. 3 ph. 60 cy.
1	200	Whse.	Non-condensing 150# I.S.P 7# B.P. 240 V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA	Make	Type	Ph	Voltages
1	5000	Whse.	OISC	3	3300x26400/13200
1	3500	G. E.	WCT	3	13800/6900x2300/440
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G. E.	HVDDJ	1	66000x13800
2	1750	G. E.	WCT	3	13800/6900x2300/410
1	1000	G. E.	H	1	2200x480
1	1500	G. E.	HT	3	13200x2300
3	1250	G. E.	H	1	6600x550
2	1000	Pitts.	OISC	3	2300x460
4	1000	Al. Ch.	OISC	1	2300/4000x460
3	1000	Wagner	OISC	1	13200x220/440
1	300	Kuhl	OISC	3	13800x460
3	200	Whse.	OISC	1	13200x120/240
1	150	G. E.	HT	3	25000x120/208
3	150	Whse.	OISC	1	33000x2300/4000
2	75	Upte	OISC	3	4160x240

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POWER EQUIPMENT

TURBINE UNITS

1—2500 KVA G.E. 3/60/480V. 3600 RPM NON-CONDENSING Nozzled for 150 psig.

1—1250 KVA Al. Ch. 3/60/480 V. 3600 RPM, Terry EXTRACTION turbine nozzled 250 psig 550° TT 40,000# extr. 25 psig. Surf. Cond.

1—938 KVA West. 3/60/480 V. 3600 RPM Terry EXTRACTION turbine nozzled 250 psig 500° TT 10,000# extr. 50 psig. Surf. Cond.

1—375 KVA G.E. 3/60/480 V. 3600 RPM, NON-CONDENSING nozzled for 150 psig, 5-10 psig back pressure.

BOILERS

1—50,000# Edgemoor bent tube 225# WP 490° TT Coxe chain grate stoker and economizer. New 1939.

2—502 HP Heine water leg type 200# WP 480° TT Coxe chain grate stokers. New 1929.

DIESEL & GAS ENGINE UNITS

1—1600 HP Fair. Morse 2300/4150 V. 60 cy.

1— 275 HP Ing. Rand. 240 V. 60 cy. (Gas)

1— 250 HP Buckeye 240 V. 60 cy.

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	V.—DC	A.C.	RPM
1	3000	G.E.	250	13200	514
1	1500	G.E.	600	4150	600
2	1000	West.	660	4150	900
1	200	West.	275	2200	500
2	150	G.E.	250	2300	1200
1	75	Ridgway	125	220	1200

SYNCHRONOUS MOTORS

QU.	HP	MFR.	VOLTAGE	RPM
2	2000	West.	13200	1200
1	900	A.C.	2200	180
2	700	West.	2300	200
1	600	G.E.	2300	240
1	300	G.E.	2300	600
1	300	West.	2300	900
2	250	G.E.	2300	257
1	200	G.E.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	12500	G.E.	25/60	300
1	3750	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A.C.	60/25	300
1	500	G.E.	25/62½	750
1	500	G.E.	25/60	300

OIL CIRCUIT BREAKERS—Outdoor

4— 800 A. 132 KV West. G-222A-2500-MVA
1— 400 A. 73 KV Condit FO-40-250 MVA
2— 400 A. 37 KV G.E. FHKO-136-350 MVA
4— 600 A. 15 KV G.E. FHKO-139-750 MVA
1—1200 A. 15 KV G.E. FKO-139-350 MVA
7— 600 A. 15 KV G.E. FK-155-28-350 MVA f/D

TRANSFORMERS

4— 2500 KVA Mel.	69000—13800
4— 500 KVA West.	69000—6900
3— 400 KVA G.E.	66000/33000—2300/4160
3—1250 KVA A.C.	44000/11500—460
3— 150 KVA Mol.	44000—2400/7200
3— 75 KVA West.	44000—7200/12470
4—5000 KVA G.E.	40935/70900 Y—14500
3—3333 KVA G.E.	33000/11000—2400/7200
3— 333 KVA G.E.	33000—7200/12470 Y
3— 200 KVA A.C.	33000—2400/7200/12470
3— 75 KVA Wag.	33000—7200/12470 Y
3—1250 KVA G.E.	26400/13200—2400
4—1500 KVA A.C.	25400/44000—6900/13800
4— 450 KVA A.C.	25410/44000—13280/23000
3—1000 KVA Mel.	22000—2300
3— 100 KVA G.E.	22000—7200/12470 Y
1— 3000 KVA Stand.	19050/33000—4160, 3 ph.
1— 600 KVA Stand.	13200—2300, 3 ph.
1— 450 KVA Penn.	13200—2400, 3 ph.
3— 333 KVA West.	13200—2400
3— 200 KVA G.E.	13800—2300
3— 250 KVA Pitts.	7200—220/440
3— 100 KVA G.E.	7200—240/480
3— 150 KVA Wag.	6900—2300
3— 37½ KVA G.E.	6900—230/460
3— 150 KVA Wag.	4800/2400—240/120
3— 333 KVA G.E.	2300—230/460
3— 250 KVA G.E.	2300/4000 Y—115/230
3— 200 KVA West.	2400—240/480
3— 150 KVA West.	2400—230/115
1— 100 KVA G.E.	2300—575, 3 ph.
3— 75 KVA A.C.	2400—240/480
6— 50 KVA West.	2400—114/228 Dry Type

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SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	Speed
2000	*G. E.	MT-12	600
2000	*G. E.	MT-30	237
1500	*G. E.	MT-30	240
1250	*West.	CW	600
1000	*West.	CW	250
700	*A. C.	ANY	720
500	*G. E.	IM	3600
500	*G. E.	MTP	1800
500	*G. E.	MT	450
500	West.	CW	350
400	A. C.	ANY	440
400	A. C.	3-brg	450
400	*G. E.	MT412	450
350	West	CW	900
300	*G. E.	IM13A	1800
300	*G. E.	MT410	450
250	West.	HF15H	600
250	*Westgh.	HF	1200
200	*Westgh.	CW	1200
200	G. E.	IM15	1200
150	G. E.	MT549 BB	1800
125	G. E.	1K15A	585
125	*G. E.	MT549	1800
125	G. E.	IM15A	600
100	A. C.	ANY	900
100	G. E.	IM13A	1800
100	G. E.	IM15A	450
75	Northw'n	HW50	1800
75	G. E.	MT347	1200
75	G. E.	MT356	900
75	G. E.	IM	720
75	G. E.	IM14	600
60	West	CW762C	900
50	G. E.	IM11A	1800
50	*A. C.	ARY	1800
50	West.	CW636A	1200
50	G. E.	MT346	720
50	G. E.	IM14	450
40	*G. E.	MT532	1200
40	G. E.	MT336	1200
35	Fair-Mor.	UAB (vert)	1800
35	G. E.	IM	1200
30	G. E.	MT532	900
30	G. E.	MT326	1200
25	G. E.	MT522	1200
25	G. E	MT526	900
20	G. E	MT322	1200
20	G. E	IM	900
15	L. Allis	OH326	1800
15	A. C.	ARY326	1800

TRANSFORMERS

Dry Type — Air Cooled
STANDARD or SPECIAL RATINGS
Made to your Specifications
Any Quantity — Quick Deliveries
Send us your Inquiries for Prompt Quotations

TRANSFORMERS

KVA	Make	Phase	Primary	Secondary
1000	West.	3	4800	480
850	West	3	34160	455
667	G. E.	1	500	480
667	G. E.	1	3000	480
500	American	1	2400	240/480
400	G. E.	1	2300	230/440
400	West. (air)	3	12000	213
300	G. E.	3	13800	240/480
300	G. E.	3	2400	240/480
250	G. E.	1	4160	240/480
200	Wagner	1	2400	575
167	A C	1	2400	120/240
100	Pittsburgh	1	2400	240/480
100	G. E. (Py'l)	1	2400	120/240
50	West.	1	2400	120/240

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	Speed
1750	*G. E.	K	3600
1000	*G. E.	K6347S	1800
750	*A. C.	TEFC	1800
750	*G. E.	KT	720
700	G. E.	FT	3600
500	*A. C.	6316SW	1800
400	*G. E	KF559	3600
300	*West.	CS	3600
250	*L. Allis	OGX148	720
250	G. E.	IK	600
200	*G. E.	FT549Y	3600
200	A. C.	ARWX	3600
200	*G E.	IK13B	1800
200	A C.	ARWWT	600
200	G. E.	1K17	600
200	*West.	CS	600
200	*G. E.	K6325S	514
150	A. C.	AR DP	3600
150	*A. C.	AN	1800
150	G E	IK13A	1800
150	G. E.	IE-K	1200
150	G. E.	KT558	900
150	*G. E	KT566 TEFC	720
150	G. E	1K16	600
150	*West.	CS 3-brg.	600
125	West	CS504S	3600
125	*A. C.	AR226	1800
125	*Reliance	AA6085 BB	900
125	A. C.	AR	900
100	L. Allis	EX114SExPr	3600
100	*G. E.	FT542Z	1800
100	G. E	FTRP543	1800
100	*West.	CS	1800
100	A. C	AW	1200
100	G. E	1K13A	1200
100	U. S.	CFU (vert)	1200
100	*West.	CS (vert)	1200
100	*West.	CS774C	900
75	West.	CS445S	3600
75	G. E.	KT537	1800
75	G. E.	IK11A	1800
75	A. C.	AR505	1200
75	Howell	TEFC	1200
75	G. E.	KF542 BB	1200
75	*A. C.	AR (vert)	900
75	A. C.		900
75	A. C.	AN	720
75	G. E.	IK	600
75	Fair-Mor	H24B BB	514
60	G. E.	KF444Z	3600
60	*West.	CS504S	1800
60	A C.	APZ445S TEFC	1800
60	*West.	CS505S TEFC	1800
60	*G. E.	KT537	1800
60	A. C.	APZ504U TEFC	1200
60	West.	CS752C	1200
60	West.	GS857C TEFC	1200
60	A. C.	AR504U	1200
60	*G. E.	KT343	1200
60	G. E.	KT343	1200
60	Cr.-Wh	SC505	1200
60	A. C.	AR823	900
60	A. C	AR826F	514
50	G. E	K404	3600
50	West.	CS205S	3600

Hundreds of smaller motors!
WRITE FOR STOCK LIST

SPECIAL OFFERING

BRAND NEW, Surplus Stock 2 HP to 60 HP
HIGH-TORQUE, HIGH-SLIP MOTORS Designed for punch press and similar service—good for standard applications, too. Write for list and BIG DISCOUNT.

M. G. SETS

KW	Make	AC	DC
2400	West. (3-u.)	4800	525
1000	West. (3-u.)	11000	137/275
500	AC-West.	2300	250
450	G. E. (3-u.)	2300	125/250
400	A. C.	2300	120/240
300	Cr. Wh.	440	250
200	Ridgeway	2300	250
200	G. E.	2300	250/275
200	G. E.	440	550
200	West.	2300	275
200	G. E.	440	600
150	G. E.	2300/440	250
150	G. E.	2300/4000	125/250
150	G. E.	440	275
125	G. E.	440	300
125	West.	440	250
100	G. E. (25 cy)	440	125
100	G. E.	2300	250
100	Ridgway	2200	275
100	West.	220	125
100	Elec. Machy.	220	125
90	G. E.	220	250
90	G. E.	440	60
75	Reliance	2300/440	250
75	G. E	440	125
60	A. C	2300	110
50	G. E	440	250
40	A. C.	220	125
35	West.	2200	125
30	G. E.	220/440	250
25	Cr.-Wh.	440	125
20	G. E.	440	250

D. C. MOTORS

Mill Type—Pedestal Bearing Reversing

HP	Make	Volts	Speed
1500	West.	525	600
1200	West.	525	600
1000	West.	450	600

230 Volts—Constant Speed

250	G. E. (550 v)	MPC4	700
200	Cr.-Wh.	CM	500
175	G. E.	ELC	750
100	G. E.	RC34	2500
100	G. E.	RC19	575
100	West.	MC90	460
50	G. E.	RC35	700
50	G. E.	DLC-204	650
35	Cr.-Wh.	CM351	700
30	Cr.-Wh.	CCM	440
30	Sprague	C-60	240/300
25	West.	SK100L	1100
25	G. E.	RC32	900
25	G. E.	RC32	800
25	A. C.	E130	775
25	West.	SK133	575

Many others—1 HP and up
Also Variable Speed and 115 Volt Motors

AC SYNCHRONOUS MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

HP	Make	Type	P.F.	Speed
1420	*West		.7	900
800	*G. E.		1.0	1800
710	*G. E.	ATI	1.0	720
700	*G. E	TS975Z	1.0	1200
600	*G. E.	TS7640	1.0	900
600	*G. E.	TS	1.0	600
600	*G. E.	ATI	1.0	240
400	West.	HC	1.0	900
300	G. E.	ATI	.8	1200
300	G. E.	ATI	.8	900
300	*G. E.	ATI	1.0	720
300	Ideal	SNS	1.0	257
250	*Cr. Wh.	251S4	1.0	1800
220	*West.		1.0	600
190	El. Mhy.	2S	1.0	720
175	*West.	HR	1.0	360
150	*West.	HR	1.0	300
125	*G. E.	ATI	1.0	900
125	*El. Mhy.		1.0	900
125	*G. E.	TS	1.0	277
115	El. Mhy.	EM	1.0	240
100	*G. E.	ATB	.8	900
100	*West.		1.0	900
100	Ideal	SNS	1.0	900
100	G. E.	TS6184	1.0	450
20	Fynn-W	15VRN		1200
15	Ideal			1800
15	Century	ARC365	1.0	1200
7½	Ideal			1800

WE WILL BUY YOUR SURPLUS MOTORS
Hoists, Compressors, Transformers
CASH OR TRADE
Write full details for our OFFER BY RETURN MAIL

AC SYNCHRONOUS GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

KVA	Make	Type	Speed
1750	*West		900
1500	G. E.	ATI	720
312	G. E	ATI	900
300	*G. E	ATI	720
225	G. E	ATB	600
187	West.	ES	720
100	*G. E.	ATB	900
60	Fair.-Mor.	B	900
55	G. E.	ATB	1200
50	G. E.	ATB	1200
50	West.		1200
50	G E	ATB	900

Phone: CAnal 6-2900

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1320 West Cermak Road, Chicago 8, Ill.

REBUILT AND NEW ELECTRICAL POWER EQUIPMENT FOR INDUSTRY

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

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America's largest source of New and Remanufactured Diesel Power

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W. U. WIRE • CABLE — AGSCOMACH

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1980	Nordberg	TS-217	3000	225
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
1000	General Motors	16-567B	1440	720
750	General Motors	12-567	1080	720
*500	General Motors	8-278A	750	720
500	Baldwin	VO-8	750	514
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*480	Worthington	DD-8	700	360
*400	Ingersoll-Rand	S-8	600	720
*400	Sterling	VDS-8	600	1200
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
*160	Buckeye	80	240	600
*150	Worthington	CC-4	225	450
100	General Motors	3-268A	150	1200
60	General Motors	6-71	90	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

**—indicates NEW unit.*

ONE YEAR GUARANTEE!

ELECTRICAL EQUIPMENT

REBUILT N.I.S.A. STANDARDS

AC Motors — 3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.
500(3)	1800	West.	Syn. 2200 V.	PedBrgW Exc
450	1800	AC	SC 2200 V.	AW-SB
350	1800	AC	SC 2200 V.	AW-SB
200	1800	GE	SC	K6333S TEFC
150	1800	GE	SR	M-6328 TEFC
150	720	Allis-Chal.	SR	AR Hoist
100	3600	Wagner	SC	191L-12B
150	750	GE	SR (25 cy)	IM
60	1200	West.	SC	CS505 Spl. Pr.
125	1200	AC	SR	ARY-BB
100	900	GE	SR	MT-SB
100	1800	GE	SR	IM
100	725	Allis-Chal.	SR (25 cy.)	ARY-3 Brg.
75	900	GE	Syn 2200 V.	TS-DC Exciter
75	1200	Wagner	SC	21-W
75	900	West.	SR	CW-752C
75	600	GE	SR	IM
75	600	GE	SC 2200 V.	KT-558
60	1200	GE	SC	I-K
60(3)	1200	Allis-Chal.	SR	ARY-505 BB
60	900	AC	SC 2200 V.	ARZ-TEFC
50	1800	GE	SC	IK
50	1800	FM	SR	HV-BB
50	1200	GE	SR	MT-336
50	720	CW	SC	SC
50	600	CW	SR	SR
40	3600	GE	SC	K-405xExp.Pr.
40	1800	GE	SC	KT
40(2)	1200	Rel.&West.	SC	Fr. 115-RB
40(2)	1200	AC&Rel.	SC	TEFC-BB
40	900	West.	SR	CW
40	720	AC	SR	ANY
30(3)	1800	AC	SC	ARZ-TEFC
30	1200	AC	SC	ARZ-TEFC

SPECIALS

1—500 KVA Trans. West'hse Type ASL, 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount —Freight allowed. **SEND US YOUR INQUIRIES.**

NATIONAL ELECTRIC SERVICE CO.
321 Lombard St., St. Louis 2, Mo. Phone — Chestnut 4603

FAIRBANKS-MORSE DIESEL PLANT

2—120 HP F.M. Model 32E12, two cylinder, two cycle, 12" x 15" 360 RPM, engines. Direct conn. to: 96 KVA F.M. AC Alternators 3/60/240 V., with belted exciters, compressor, tanks, switchboard and spare parts.

ALJON ELECTRIC DIESEL CO.
904 Pacific St. Brooklyn 38, N. Y.
STerling 3-6515

STORAGE & PRESSURE TANKS
Located Mich.-Mo.-Fla., N.J. & Conn.

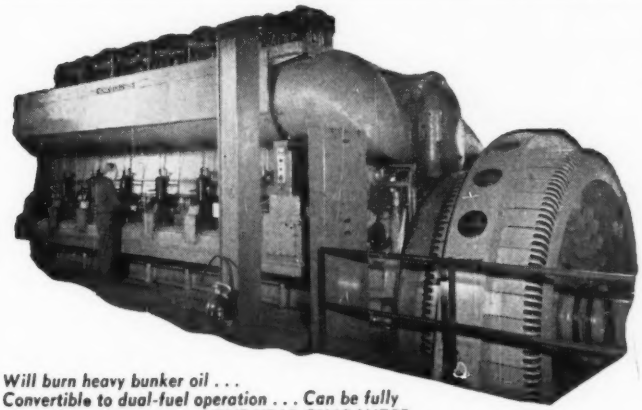
8—12,000-17,000 & 20,000 Gal. 90 Lb.
16—10,000-15,000 & 20,000 Gal. Storage
9—42,000, 120,000 & 240,000 Gal. Storage
10—10,000 Gal. Cap. RR Car Tanks

LESTAN CORP., ROSEMONT, PA.

CURRENT MODEL·· DIESEL

1980 KW NORDBERG MODEL TS-217 DIESEL UNIT

Heavy Duty • Slow Speed • Available Immediately



Will burn heavy bunker oil . . .
Convertible to dual-fuel operation . . . Can be fully inspected and test run . . . ONE YEAR GUARANTEE

ENGINE: (2800 BHP net) Nordberg, 7 cylinder, 2 cycle Diesel engine at 225 RPM, 21¼" bore, 29" stroke, cylinders arranged vertical in line, solid injection.

GENERATOR: 1980 KW, 2475 KVA General Electric generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 225 RPM.

(50 cycle rating 1650 KW at 187 RPM)

UNIT AUXILIARIES AND ACCESSORIES

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust muffler, lubricating oil cooler, Young evaporative type cooler for jacket water cooling, thermostatic control valve, fuel oil day tank with transfer pump and oil meter, 2 lubricating oil storage tanks, lubricating oil transfer pump, Diesel-driven air starting unit, air tanks, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake exhaust, water, lubricating oil, fuel oil, and air. Generator and exciter control switchgear.

The unit above affords a rare opportunity to procure a complete, modern current model, heavy duty, slow speed diesel set at a great saving. It represents an offering which cannot be duplicated anywhere in the diesel market today.

Act now . . . Phone, Wire, or Write for Full Details

ALL OWNED AND OFFERED EXCLUSIVELY BY

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A.G. SCHOONMAKER CO., INC.

"America's Largest Source of New and Remanufactured Diesel Power"

Western Union — WUX —
A. G. Schoonmaker Co. Inc., N. Y.
CABLE:—AGSCOMACH

50 CHURCH ST., NEW YORK 7, N. Y.

Plants and Warehouses: Jersey City, N. J. and Sausalito (S.F.), California

COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

84x20′ HRT Boiler, Stack, Stoker, 1941
200 & 500 KVA Wagner Transformers
33′x18″ Belt Conveyor with Motor
200/300 CFM Steam Driven Air Compressor
750 & 515 KVA Engine-Generator Units
700 KW, 250 V. Direct Current Generator
75 HP (4) Slip Rg. Motors—900/720 RPM
24″x48″ Corliss Engine—good price

H. & P., 6719 Etzel, St. Louis 14, Mo.

A FEW SPECIALS

BOILERS

Cleaver Brooks model OB25, 8600 lbs. steam, 200 lbs. pressure, Oil fired, "1949"
1000 H.P. Combustion, 4 Drum, 200#
812 H.P. (2) Combustion, 4 Drum, 300#
548 H.P. (2) Keeler "CP" "1948" 450#
500 H.P. (2) BW straight tube 200#
400 H.P. BW 3 Drum, 160# "1949"
300 H.P. BW 200# Sec. HDR
256 H.P. Combustion, "1949" 150#
250 H.P. BW 3 Drum, 225# "1948"
205 H.P. Scotch, 175#, Oil
147 H.P. Kewanee "1948" 125#
100 H.P. Cleaver Brooks, 150# (Package)

TURBO UNITS, non-condensing

937 KVA GE 480/240 v.; 0/15# bp
625 KVA Al.Chal.-Elliott 480/240 v.; 0/15# bp
375 KVA Al.Chal.-Elliott 240/480 v.; 0/25# bp
125 KVA GE 240/480 v.; 0/30 bp Turbine: 568 HP. Murray (new)

STEAM ENGINE UNITS (Uniflow)

375 KVA (2) Wghse.-Skinner, 3/60/600 v.
312 KVA GE-Skinner 240/480 v.
250 KVA (2) GE-Skinner, 240/480 v.
210 KVA (2) GE-Ames, 240/480 v.
187 KVA Wghse.-Ames vertical, 240/480 v.

DIESEL UNITS (Modern)

1136 KVA (4) FM, opposed p.ston, 720 rpm
590 KVA FM 33E14, 300 RPM
480 KVA FM 33E14; 300 RPM
300 KVA Fairbanks Morse 277 rpm
250 KVA FM, 33E14; 300 RPM
220 KVA (2) Wghse-Buckeye "E" 400 rpm
187 KVA Ideal-Buckeye "E" 400 rpm
185 KVA FM, 32E14; 300 RPM
125 KVA GE-Hercules, 1800 RPM

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

Check with WAGNER FIRST!

✓ Complete Stock A.C. & D.C. Motors and Generators

✓ New and "Certified Rebuilt"— UP to 1000 H. P.

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse syn cond		4000/2300	900
625	Gen Elec	ATB	2300	450
625	G E 25 cycle	ATB	2300	750
600	Gen Elec	ATB	480	900
625	El Machy	Late	240/480	1200
485	Allis Ch	1 brg	480	400
350	El Machy	1 phase	480	1200
312	Gen Elec.	ATB	240/480	600
275	G E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec	ATB	2300	900
150	Whse		2300/480	600
125	Gen. Elec (2)	ATB	240/480	900
112	Gen. Elec	ATB	240/480	900
90	Gen. Elec.	ATI	240/480	1200
75	Gen. Elec.	ATI	240/480	1200
75	El. Machy		2300	900
56	G. E.	ATB	240/480	1200

LOW VOLTAGE M-G SETS—2

Whse. 3636 amp. 20/55 V. DC gen. w/synch. motor 220/440 V. 720 RPM and exciters. Modern, low price.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Alls. Ch. b.b.	EW	350	1200
250	Gen. Elec.	MPC	250	600
200	Whse.	SK	250	1200
105	Century b.b.	1500 amp.	70	1200
100	Allis. Ch.	E	125	1200
100	Gen. Elec.	RC37	250	1200
75	G. E. bb (2)	CDM135	125	750
75	Whse.	SK	250	900
75	Cont. b.b.	D109X	125	1200
75	Gen. Elec. (2)	CD115	250	1500
60	Whse.	SK160	250	1000
50	Whse.	SK	250	1100
50	Allis. Ch.	EW	125/250	1200
50	Gen Elec.	RC	125	1200
40	Gen. Elec.	CD103	250	1500
40	F. Morse b.b	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

ADJUSTO-SPEDE MOTOR

60 HP Louis Allis type OX-504Y b.b. 3/60/220/440 V. 400/1700 RPM with brake.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis. Ch b b	EW	350	1000
250	Gen. Elec.	LDR	250	450/850
250	Whse.	SK	230	850
200	Al Ch. b.b.	E	250	500/1000
150	Whse.	SK-201	230	300/900
100	Gen. Elec. (2)	RC37	230	900
75	Whse.	SK170	230	635
75	G. E (2)	CD 115	230	1150
60/75	Gen. Elec.	C	230	500/1200
50	Whse.	SK150	230	750
50	Reliance b.b.	65IT	230	750
50	Gen. Elec.	CD123	230	550/1200
50	Gen. Elec.	RC33	115	1100
50	Cr.Wh.b.b.(3)	FH	230	1750
50	Whse.	SK183	230	300/900
40	Allis. Ch.	E-121	230	1750
40	Gen. Elec. (2)	CD103	230	1150
40	Gen. Elec	RC32	550	1200
40	F. Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD85	230	1750
25	Gen. Elec.	CD105	230	575/1720
20	Century b.b.	DN330	230	3500
20	G. E. series	CO-1826	230	875
20	Whse. b.b (2)	SK97	550	900

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	G. E.	Slipring	2300	400
750	Whse.	Synch.	2200/4000	900
700	G. E	Synch	2200	514
600	G. E.	Synch.	220/440	257
600	E M	Synch.	480	1200
600	G. E. (2)	Synch	2200/440	360
550	G. E.	Sq. Cage	2200	3600
500	G. E.	Slipring	2200/440	450
500	G. E.	Sq. Cage	6600/4000	1800
500	G. E.	Synch.	440	900
450	Allis. Ch.	Synch.	480	400
450	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis. Ch.	Sq. Cage	2200	1200
350	Whse. (2)	Slipring	2300	450
350	G. E.	Slipring	2200/440	600
300	Allis. Ch.	Slipring	220/440	900
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al Ch.	Slipring	2300	514
300	G. E.	Slipring	440	360
250	G. E	Slipring	2300	450
250	G. E	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Whse. Ex. Pf.	Sq. Cage	2200/440	1200
200	Allis. Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	G. E.	Sq. Cage	220/440	600
200	Cr. Wh	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G E.	Slip Ring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E	Slipring	220/440	360
200	Whse	Sq. Cage	220/440	1800
200	Rel. b.b	Sq. Cage	220/440	1200
200	E M.	Synch.	220/440	514
175	Whse.	Synch.	220/440	360
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G. E.	Slipring	220/440	450
150	Allis Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Slipring	220/440	600
125	G. E.	Slipring	220/440	450
125	E. M. (2)	Synch.	220/440	1800
125	G. E	Slipring	2200/440	720

M-G SETS

KW	Mfr.	Input V		Output V	
500	Whse.*	2300	AC	250	DC
300	G. E.*	440	AC	250	DC
300	Allis. Ch.	2200/440	AC	125/250	DC
300	Whse.*	2300	AC	600	DC
250	Allis. Ch.	2200/440	AC	350	DC
200	Whse.* (2)	220/440	AC	55	DC
200	G. E.*	220/440	AC	250	DC
200	Gen. Elec.*	220/440	AC	125	DC
150	Whse.*	2200/440	AC	275	DC
105	Century b.b	220/440	AC	70	DC
100	Gen. Elec. (2)	2200/440	AC	250	DC
100	Al. Ch.	220/440	AC	125	DC
100	Delco b.b.	220/440	AC	125/250	DC
90	G. E.* (2)	220/440	AC	125	DC
90	Star* b.b.	220/440	AC	240	DC
75	Cont. b.b	220/440	AC	125	DC
75	G. E. (2)	220/440	AC	250	DC
60	Gen. Elec.*	220/440	AC	60	DC
50	Whse.	220/440	AC	250	DC
50	Gen. Elec.	220/440	AC	125	DC
50	Allis. Ch.	220/440	AC	125/250	DC
45	Gen Elec.*	220/440	AC	60	DC
40	G. E. (2)	220/440	AC	250	DC
40	Gen. Elec.	220/440	AC	600	DC
30	Whse.	220/440	AC	250	DC
25	Whse.	220/440	AC	125	DC
25	Gen. Elec.	220/440	AC	250	DC
20	Star b.b.	220/440	AC	120	DC

*Synch. motor.

THESE ARE PARTIAL LISTINGS . . . 10,000 OTHER UNITS IN STOCK

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FOR SALE

(6) OIL FIRED B&W BOILERS

Cross Drum Sinuous Headed straight tube type Heating surface 11417 sq. ft.—1141.7 HP—210 P.S.I.G. design pressure—200 P.S.I.G. working pressure—75,000 lbs./hr. capacity—steam temp., saturated—1024 cu. ft. furnace volume —200° feed water temperature.

(2) B&W WATER TUBE BOILERS

ASME code—from ATR tug—built 1943. 15,000 lbs. steam/hr./unit (normal) 18,000 lbs. steam/hr/unit max. Design pressure—268 lbs/sq. in. —total steam at drum outlet (saturated) 409 —forced draft—turbine driven blowers—1508 sq. ft. boiler heating surface. Gas or oil.

(4) 300 KW G.M. 8-268A DIESEL GEN.

G.M. diesel generator sets—120/240 volts DC —1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

(2) 60 KW CUMMINS DIESEL GEN.

120/240 volts DC—250 amps.—Model H engine —6 cylinder—heat exchanger cooled.

(2) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed 440/60/3 AC generator set.

75 KW WAUKESHA DIESEL GEN.

Heavy duty—totally enclosed—with built-in switchgear. 75 KW — 230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

(6) 300 KW TURBO GENERATOR SETS

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stablized shunt generator. With switchgear. Built 1945. Excellent condition.

(1) SUPERIOR HEAVY DUTY DIESEL

510 HP at 360 RPM—5 cylinder—14½x8—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile & saw mills, etc. Excellent condition. Immediate delivery.

ELECTRIC WINCHES

50 HP—230 volts DC—built in controls—5 ton and 10 ton.

THE BOSTON METALS CO.

313 E. Baltimore Street

Baltimore 2, Md.

Curtis 7-5050

GUARANTEED REBUILT

We offer the following slip ring motors. They are all 220/440 volt, 60 cycle, 3 phase. We can also furnish controls for these motors. This is a partial listing so CALL OR WIRE COLLECT for any other motor requirements.

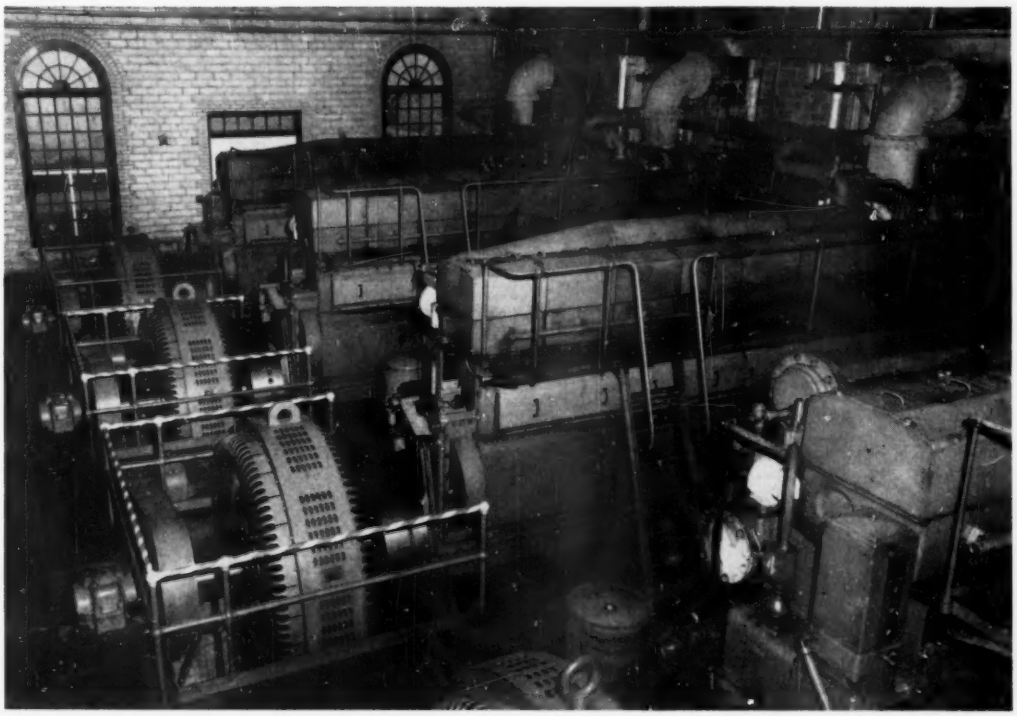
Quan.	H.P.	Make	Type	Speed	Descrip.
1	300	G.E.	I-M	900	S. B.
1	150	G.E.	I-M	1200	S. B.
1	125	G.E.	I-M	720	S. B.
1	100	G.E.	I-M	1800	S. B.
1	100	West.	CW	1200	S. B.
1	100	West.	CW	900	S. B.
1	100	G.E.	I-M	720	S. B.

POWER EQUIPMENT COMPANY

8 CAIRN ST., ROCHESTER 2, N. Y.

P. O. BOX 534 — Tel: Genesee 5629

MODERN 4240 KW DIESEL ELECTRIC POWER PLANT



3—1180 KW 80% P.F. 1475 KVA Westinghouse generators 3 phase 60 cycle 2400 volts, 360 RPM, direct connected to

3—1685 HP Worthington diesel engines, fully enclosed, type SEH-8, 8 cylinders, 16" x 20", 4 cycle, direct injection, heavy duty, turbo charged, 360 RPM.
Installed New 1948—Excellent Condition—Can Be Shown in Operation.

1—700 KW 80% P.F. 875 KVA Westinghouse generator, 3 phase 60 cycle 2400 volts, 327 RPM, direct connected to

1—1000 HP Worthington diesel engine, fully enclosed, type EE-8, 8 cylinders, 16" x 20", 4 cycle, direct injection, heavy duty, 327 RPM.
Installed New 1939—Excellent Condition—Can Be Shown in Operation.

The generators are complete with direct connected exciters and metal clad switchgear.

The engines are complete with air starting equipment, pumps, heat exchangers, oil coolers, oil purifiers, exhaust silencers, water softener and piping.

The generators of the above units can be reconnected for 240, 480 or 600 volts. The engines of the above units can be adapted for dual fuel operation on natural gas or oil.

Write, Wire or Phone For Further Details and Prices.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 1-9514 **CLEVELAND 14, OHIO**

FOR SALE
VERTICAL WATER TURBINE
Manufactured by S. Morgan Smith Co.

252 HP, 277 RPM, 14' Head. GE 175 KVA Generator 3/60/440. Exciter, Woodward Water Wheel Governor Type HR. With AC Motor and Automatic Switch. 2—1 KVA AC Transformers, Knife Switch, Gate with Operating Wheel. Woodward Rotary Oil Pressure Pump with GE 2 HP 3/60/220/440 Motor Drive and Magnetic Switch. Subject to Prior Sale.

CONTINENTAL MACHINERY AND EQUIPMENT CO.
Ostend & Ridgely Sts. Baltimore 30, Md.

FOR SALE
18 NEW TURBINES
4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 29000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

FOR SALE
MODERN 1000 KW Turbo-Generator
in excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.
6101 Tacony St. Philadelphia 24, Pa.

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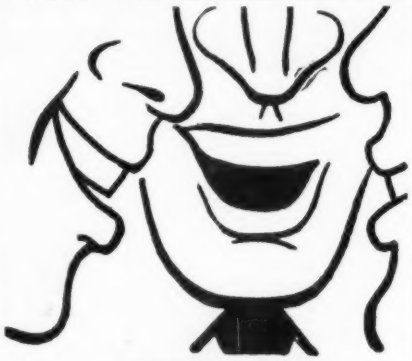

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1500	G.E.	Pyranol	3	4150x2400
1	1000	G.E.	Auto	3	4150x2400
2	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts.	OISC	1	4800/4150/2400 x240/480
3	333	Whse.	OISC	1	2400x575
1	333	G.E.	H	1	13200x220 440
2	300	G.E.	H	1	13200x440
4	200	G.E.	H	1	13200x440
1	200	G.E.	HT	3	2400x240
2	150	Pitts.	ODSC	1	240x120/240
3	50	G.E.	H	1	4800x120/240
3	50	A.C.	H	1	230x120/240
1	25	G.E.	H	1	460x120/240
1	20	G.E.	Novalux		2400 6.6 Amps
2	25	G.E.	H	1	575x115/230
3	25	Nlag.	OISC	1	2400x460
3	25	Wstghse	SK	1	440/220/110

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 Syn.
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	Whse.	720	275	2300/4150 Syn.
1	300	C.W.	1200	230	3-unit 2400/4160SR
1	300	G.E.	1200	230	2400/4160SR
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C.W.	1200	230	440 SC
1	150	3 Unit G.E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C.W.	1200	125	2300 S.C.
1	100	G.E.	900	250	2300 Syn.
3	60	G.E.	1200	125	208 Syn.
2	30	G.E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720	--	4150
1	175	G.E.	720	ATI	2300
1	150	G.E.	720	ATI	2300
1	150	G.E.	1800	TS	220
1	150	Whse.	900	181G	220

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
2	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	G.E.	600	MT	440
3	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	100	G.E.	600	IM	440
1	75	G.E.	600	IM	440
1	60	G.E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G.E.	1200	MFC
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
1	30	C.W.	700	CM
1	35	G.E.	860	RC
1	25	Whse.	835	SK

RECTIFIER

500 KW, 250 V. D.C. Allis-Chalmers, 2000 Amp. Type 6-ES-12. 599 KVA, 13,200 volts to 244 volts neutral. 6 phase. New 1951. Magna Blast.

Member of The National Industrial Service Association, Inc.

"FOR POWER"

J. L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

FOR SALE

SWITCHGEAR

General Electric 4160V, 3 phase, 60 cycles, 1200 amps. with three type AM-2-4/4.16 circuit breakers, swing panel, synchroscope, cyclemeter AC voltmeter, AC ampere meter, kilowatt meter, etc. *(brand new—age 1953.)*

FOR SALE

WESTINGHOUSE TURBINE

And generator, condensing and extraction, 185# initial pressure, 10# extraction pressure, with LeBlanc model #13 Jet condenser, Elliott strainer, air pump, circulating pump, etc. Age 1924, excellent condition, Westinghouse Generator age 1924, rewound 1953, 4160V, 3 phase, 60 cycles, 3125 KVA *(like new.)*

FOR SALE

UNIT SUB STATION

General Electric pyranol filled transformer 4160V, 3 phase, 60 cycles to 440V, 3 phase 60 cycles complete with type AL-2-50 tie breaker 10 type AL-2 breakers 400 amps. 2 spare cubical, AC volt meter, A.C. ampmeter kilowatt meter, age 1953, *(brand new.)*

FOR SALE

CIRCUIT BREAKER

General Electric air circuit breaker, type AL-2-100 4000 amps. 4160V, 3 phase, 4 poles, age 1953, *(brand new.)*

FOR SALE

TRANSFORMER

General Electric, pyranol filled transformer, 4160V, 3 phase to 440V, 2 phase, 60 cycles, 3125 KVA, could be easily rewound to 3 phase, age 1953, *(brand new.)*

Write for price and full specifications to

MR. CHARLES DEAR,

A. D. JUILLIARD & CO., INC.

Atlantic Mills Division

120 Manton Avenue

Providence, Rhode Island

Telephone: Elmhurst 1-9000

COMPRESSORS
VACUUM PUMPS
DISTINCTLY DIFFERENT
IN QUALITY — IN PRICE

Gas • Diesel • Electric • Steam

AMERICAN REBUILTS

55 CFM Lindsay (GAS) Portable
60 CFM Worthington (GAS) Portable
70 CFM Smith (GAS) Portable
89 CFM 6 x 7 Worthington HB, 15 HP Elec.
105 CFM Worth-IR-CPT Portable
107 CFM 7-7 x 7 Ingersoll ES-1 STEAM
129 CFM 7½ x 7 American AF1, 20 HP
160 CFM IR-Worth—Portable
165 CFM Smith 110SR Semi-Portable, 25 HP
194 CFM Worthington Semi-Portable, 40 HP
195 CFM 8-9 x 9 Worthington HS STEAM
210 CFM Worthington (GAS or DIESEL) Port
211 CFM 9 x 9 Worthington HB, 40 HP Elec.
279 CFM 11-10 x 11 Worthington HS STEAM
294 CFM 10 x 12 Worthington HB, 50 HP
315 CFM Worthington (GAS or DIESEL) Port
388 CFM Worthington Semi-Portable, 75 HP
445 CFM Gardner Semi-Portable 75-100 HP
462 CFM 12-14½ x 13 American AF-S STEAM
500 CFM Worthington (DIESEL) Portable
538 CFM Worthington Semi-Portable, 100 HP
600 CFM Worthington (DIESEL) Portable
628 CFM 14 x 13 Ingersoll ES-1, 100 HP

SELL—BUY—TRADE—RENT—REPAIR
COMPRESSORS SINCE 1902

AMERICAN AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-4848

FOR SALE
Engine-Generator Set

No. 113467 Allis-Chalmers generator, 480 volts, 98 amperes, 3 phase, 60 cycle, 277 RPM, 72 KW, direct connected to an Ames Uniflow engine, size 14 x 15, 130 PSIG and 5 PSIG back pressure. V-Belt driven Allis-Chalmers exciter, complete with panel and new Allis-Chalmers V-11 Rocking Arm type voltage regulator. Can be seen by appointment. Will be sold cheap. The above generator can be reconnected for 240 volts.

Write or phone
LEON J. BAKER
Chief Engineer
GEORGE SCHOOL, PA.

TRAVELIFT CRANE

1—Three motor, floor controlled, single Girder P&H Travelift Crane. Capacity—5 tons. Motor has 440 volt, 3 phase, 60 cycle, 3 wire system. Span 19'9". Max. lift 35'. Acid Proof Construction Throughout. Our price, $5,000.

ARTHUR G. PORTER
Lutsen, Minnesota

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that other readers of this paper can supply
or—
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that other readers can use, advertise it in the
SEARCHLIGHT SECTION

WORLD'S LARGEST INVENTORY
Established 1934 **D & B Rated**

DECEMBER BULLETIN

SQUIRREL CAGE—60 CYCLE

HP	Speed	Make
500 (3)	514	West.
450	720	G. E.
400 (2)	514	West.
300	600	West.
250 (2)	3600	G. E.
250	1200	Al. Ch.
250 (6)	900	West.
250 (2)	720	Open
200 (2)	1800	West. TEFC
200 (3)	1800	Wag., Rel.
200	1800	G. E.
200	600	Al. Ch.
150	900	G. E.
150	400	G. E.
125 (5)	1800	Al. Ch.
100 (2)	1800	West.

P.S. We stock 3500 new and rebuilt 1 HP to 100 HP

SLIP RING MOTORS

Quan.	HP	Speed	Make
1	1200	237	Cr. Wh.
1	600	1800	G. E.
1	500	1800	G. E.
1	400	514	G. E.
1	400	435	West.
1	300	500	G. E.
1	300	450	G. E.
2	250	600	G. E.
1	250	480	G. E.
2	200	600	G. E.
3	200	450	Burke
3	150	720	G. E.
1	150	450	G. E.
1	125	435	G. E.
6	100	450	G. E.
1	100	900	G. E.

Plus 837 smaller units 1 HP to 75 HP

AC GENERATORS—ALTERNATORS—CONDENSERS

Quan.	KVA	HP	RPM	Cycle
2		2500	720	60
1		1675	600	40
2		1500	900	60
1		1500	1200	60
1		1430	514	60
3		1250	720	60
1		1250	1200	60
2		1000	600	60
1		1000	750	60
1		1000	750	25
1		800	900	60
1		720	900	60
2		650	139	60
1		500	720	60
1		412	225	60
1		400	450	60
3		400	1800	60
1		375	750	25
2		375	1200	60
1		350	720	60

Plus 78 smaller units from 3 KVA to 250 KVA

MOTOR GENERATOR SETS AC — DC

Quan.	KW	Make	Volts
1	1750	AL-CH	600
3	1500	GE	125/250
1	1000	GE	600
1	1000	AL-CH	250
1	1000	West.	250
1	750	AL-CH	250
3	500	West.	250
3	500	Rotaries	250
3	400	Rotaries	250
2	300	GE	250
2	300	West.	600
1	200	GE	250
1	200	West.	600
1	200	GE	125

Plus 280 sets from 1 KW to 75 KW

DC—ADJ. SPEED—230 V.

Quan.	HP	Make	Speed
1	3600	Dynam.	800/2000
1	650	G. E.	750/2000
1	300	G. E.	400/ 800
1	250	West.	250/ 675
4	250	West.	540/3000
1	125/190	G. E.	260/ 400
1	150	West.	320/ 580
1	150	Rel.	400/1200
1	100/150	West.	500/ 750
1	100	G. E.	1050/4000
2	100	Rel.	575/1150
2	100	West.	450/1000
1	60	El. Dyn.	525/1050
2	30/71	West.	560/ 780
1	50/60	G. E.	220/1000
2	50	Diehl	400/ 800

Plus 327 smaller units 1 HP to 25 HP

TRANSFORMERS—WORLD'S LARGEST INVENTORY

All Single Phase Unless Otherwise Noted.

KVA		PV	SV
1—6000	3 ph.	24000	5040/4800
1—3750	3 ph.	22000	600
1—3750	3 ph.	22000	440
1—3000	3 ph.	22000	440
1—3000	3 ph.	22000	480
3—2500		27600	2300
4—1000	3 ph.	13800	600
3—1000	3 ph.	13800	480
3—1000		13800	230/460
1—1000	3 ph.	2200	220 Delta
3— 833		2300	575
2— 833		13800	460
3— 800		22000	2200
4— 750		2200	244/488
3— 667		13200	2300
1— 667		13200	480

PARTIAL LIST—2000 UNITS IN STOCK
FROM ONE TO 333 KVA
ALSO
AIR COOLED AND SWITCH GEAR

CONSTANT SPEED—230 V.

HP or KW	Make	Speed
500 KW (2)	West. 125/250 V.	900
400 HP	El. Dyn.	1500
400 HP	G. E.	450
360 KW	G. E. 180 V.	1300
300 KW	West. 125/250 V.	1200
300 KW	G. E. 170 V.	1200
250 KW	Al. Ch.	750
150 KW	West. 125/250 V.	750
150 KW	G. E.	1200
150 HP	West.	1615/1785
125 HP	Star	1200
120 KW (2)	G. E.	1250

Plus 675 smaller units 1 HP to 120 HP also 115 V. & 550 V. DC

ELECTRIC EQUIPMENT COMPANY
PHONE LD65 **ROCHESTER, N. Y.**

MOTORS — GENERATORS — TRANSFORMERS
MOTOR GENERATOR SETS — CONTROLS —
COMPLETE VARIABLE VOLTAGE DRIVES

29 YEARS (1924-53) SERVING INDUSTRY

BUY FROM ONE OF AMERICA'S LARGEST STOCKS

SAVE $$$$ ON YOUR PURCHASES

SQUIRREL CAGE MOTORS
3 Phase, 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	400	Cont.	NZ-806-S	2300	1200
1	400	G. E.	I-K	2200	514
1	300	Whse.	CS-890	2300	1750
1	200	Whse.	CS-873-C	2200	1160
1	200	Al. Ch.	AR	440/220	580
2	125	Al. Ch.	AR	2300	1750
1	125	Al. Ch.	AR	2300	490
1	100	Whse.	CS-663-C	440	1750
1	100	G. E.	KT-562	440/220	570
1	100	Whse.	CS-938	2200	495
1	100	F. M.	H-241B	440	435

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	V. DC	V. AC
1(3U)	2100	Whse.	720	600	4800/2400
2	1100	Whse.	720	600	2300
3	1000	Whse.	514	600	11000/6600
1(3U)	500	Whse.	1200	125/250	440/2300
2	500	C. W.	720	575	2300
1	400	C. W.	720	250	2300
1	400	C. W.	1200	125/250	440/2300
1	300	Whse.	1200	275	2200
1	250	Whse.	1200	125/250	440/2300
1	200	Whse.	1200	275	4000/2300
1	200	Whse.	1200	125/250	4000/2300
1	200	Whse.	1200	600	4000/2300
2	150	Whse.	1200	125/250	440
1	155	G. E.	720	250	2300/440
1	100	Ridgeway	1200	275	4000/2300
1	100	C. W.	1200	125	440/220
1	85	C. W.	1200	250	4000/2200
1	75	Al. Ch.	900	250	2300
1	25	Ideal	1750	125	440/220
2	25	Al. Ch.	1200	250	440/220
3	20	Al. Ch.	1200	250	440/220

Any of these sets can be furnished with D.C. panels and start ng equipment.

SLIP RING MOTORS
Constant Duty, 3 Phase, 60 Cycle Type

Qu.	H.P.	Make	Type	Volts	R.P.M.
1**	1800	G. E.	MT-498	2300	357
1**	1200	G. E.	MT-26	2200	277
2	800	G. E.	MT	2200	440
1	700	G. E.	I-M	2300	400
1**	600	G. E.	MT-20	2300	360
1**	500	Al. Ch.	ANY	2200	514
2	500	G. E.	I-16-M	2300	450
2	400	G. E.	MT-412	2200	450
1	250	Whse.	CW-937	440	1200
1	250	G. E.	MT-414	2200	300
1	250	Al. Ch.	ARY	440	720
2	100	G. E.	I-15-M	2300	514

**—Pedestal bearing design.

SYNCHRONOUS MOTORS
3 Phase, 60 Cycle

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	4350	C. W.	80	13200/6600	514
1	3000	Whse.	80	4800/2400	720
2	2100	G. E.	100	2300	360
2	2000	G. E.	80	2300	720
2	1750	G. E.	100	2200	3600
1	750	G. E.	80	2300	450
1	710	G. E.	80	2300	720
2	600	G. E.	80	2300	600
1	250	G. E.	100	2300	514
2	200	Whse.	80	440	1200
1	187	G. E.	80	440	720
1	150	G. E.	100	2200	900
1	150	G. E.	100	550	600
1	150	Whse.	80	440/220	450
2	135	G. E.	80	4000/2200	1200
3	125	El. Mchy.	100	4800/2400	900
1	125	G. E.	8	2200	900
2	100	Whse.	8	440	1800
1	100	Ideal	8	440/220	900
2	100	G. E.	8	440/220	600

We have a large stock of manual magnetic and semi-magnetic, reduced and full voltage control for use with these motors.

DIRECT CURRENT MOTORS
Variable Speed (230-VDC)

Qu.	H.P.	Make	Type	R.P.M.
1	200/250	G. E	MPC	300/ 900
1	200/250	El. Dy.	No. 22	400/1200
1	90/160	G. E.	MPC	625/1125
1	60	El. Dy.	25-S	450/ 900
1	50	Whse.	SK	250/1000
1	40	Whse.	SK-140	500/1000
1	35	G. E.	CD-125	400/1200
1	35	G. E.	CD-147	300/1200
1	32½	Whse.	SK-150	400/1200
1	30	G. E.	CDM-105	875/1750
1	25	Whse.	SK-123	500/1500
1	25	Whse.	SK-140	400/1200
1	25	Whse.	SK-111L	250/1000

Constant Speed (230 Volt)

1	350	G. E.	CD-169-A	1150
1	180	G. E.	MPC	400
2	125	Whse.	SK-184	575/ 850
1	30	Whse.	SK-110	1800
1	25	Whse.	SK-103	1150
1	25	Whse.	SK-113	950

TRANSFORMERS 60 CY.
Outdoor—Oil Cooled

Qu.	KVA	Make	Phase	Voltage
1	5000	Pitts.	3	13,200-4600
1	4500	G. E.	3	27,000/24,300-2300
1	2750	G. E.	3	14,000/13,200- 240/480
1	2750	G. E.	3	14,000/13,200-2300/4160
3	1250	G. E.	1	26,400/13,200-2400/4150
3	750	Pitts.	1	27,000/24,300-2300/4000
3	500	G. E.	1	4800- 240/ 480
3	333	Pitts.	1	22,000/11,000-2300
3	150	Al. Ch.	1	7200/ 4160- 240/480

(6)—Allis-Chalmers metal-clad cubicles, each complete with 1200 amps., 15,000-Volt drawout O.C.B., type DZ-200A, 500,000 int. capacity, motor operated lifting mechanism, Relays meters, etc.

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1— 5,000 KW 275# 11,500 V.
1— 4,000 KW 400# 2300 V.
1— 3,000 KW 425# 13,200 V. Ext/170# Non Cond.
1— 3,000 KW 175# 550 V. Cd.
1— 1,500 KW 150# 2300 V. Cd.
1— 1,500 KW 175# 550 V. Ext.
1— 1,000 KW 250# 480 V. Ext.
1— 1,000 KW 200# 4160 V. N.C. NEW 1949.

2— 750 KW 150# 250 V. D.C.
1— 500 KW 200# 4160 V. N.C.
1— 300 KW 125# 250 V. D.C.
2— 120 KW 150# 240 V. N.C.

DIESEL GENERATORS
1—1000 KVA 2400 volts
1— 200 KW 250 V. D.C.
1— 400 KW 480 volts
1— 300 KW 2400 volts
2— 75 KW 240/480 V.

BOILERS
2—50,000# 275# (1949)
3—15,000# 275# (1945)
1—400 HP Sec. Hd. 225#
1—300 H.P. 300# (1948)
1—84" HRT 150# (1942)

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1—125 KVA GE AC/3/60/220 Volts/1200 RPM
4—500 KW West. DC/120-240 Volts 1200 RPM

DIESEL ENGINES & GENERATING SETS
5—Unused GM Twins
2—Hamilton 600 HP 720 RPM w/Dir. Con. Blowers Air Start Dir. Rev. Mfg. 1942
1—G.M. 8-268A 500 HP Marine Propulsion Engine w/rev. reduction gear & access. excell.
1—Copper-Bessemer FS8 500 HP 900 RPM
* 2—Hercules DWXD w/Heat Exch. & Clutch
1—Worth. DD8 w/500 KW GE 3/60/2300V
1—100 KW Lorimer 3 ph 440 V. Diesel Set
8—30 KW Buda 3 ph. 4 wire Diesel Sets
1—30 KW Int. Har. 3 ph 4 wire Diesel Set
1—15 KW Int. Har. 3 ph 4 wire Diesel Set
2—20 KW Le Roi 1 ph 120/240 V. gas gen. sets

SYNCHRONOUS MOTORS
** 4— 75 HP Burke 3/60/220-440V/1800
** 1—125 HP El. Mach. 3/60/4800V/900
10—135 HP GE 3/60/4000 V/1200 TS963Z
* ** 1—200 HP El. Mach. 3/60/208V/1200

AC & DC GENERATORS
* ** 25—3 KW GE 3/60/120-208V/1800 w/Panels
* ** 35—5 KW I & 3/60/120-208V/1800/1BRG
* ** 20—10 KW GE 3/60/120-208V/1800/ w/Panels
* ** 8—25 KVA GE 3/60/440V/1800
2—56 KVA Star 3/60/120-208V/1200—B.B.
1—75 KVA El. Mach. 3/60/440V/900
2—500 KVA El. Mach. 3/60/440V/900 2 Brg.
4—300 KW West. DC 120-240V/1200
*UNUSED—**BALL BEARING

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210 SNEDIKER AVE. BROOKLYN 7, N. Y.
HYacinth 5-0800

MOTORS · MG SETS

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
26	1700	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600/800/900	RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G E.	230	180/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

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MOTOR GENERATOR SETS

1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 R. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
Smaller Sizes and Types—Advise Requirements

BOILERS

1—450 HP Keeler CP 160 lb. Oil
1—300 HP Keeler CP 300 lb. Oil
1—250 HP B & W 250 lb. 1948
2—200 HP Springfield Sec. Hdr. 400 psi.
1— 80 HP Cleaver Brooks Package 125 psi.
1— 60 HP Cylcotherm Package 125 psi.
1— 25 HP Dowtherm Vaporizer

Space Needed—Priced for quick sale—3—250 KVA GE Ames Vertical 4 cylinder Uniflow engines, 3/60/240/400 rpm, 140 psi, 5 lb. back pressure. Exciters, Switchboards. Condition Excellent—Contact us to inspect at Claridge Hotel Atlantic City, N. J.

DIESEL GENERATOR SETS

1—1250 KVA Nordberg 3/60/2300/360 RPM 1940
1—375 KVA GM 8-268A, 3/60/480/1200 RPM
1—250 KVA G.M. Twin 6-71, 3/60/220/440/1200 RPM Rad. Cooled.
1—187 KVA G.M. Twin 6-71 Portable, 3/60/220/440 New
1—125 KVA Cooper Bessemer 8 cyl. 900 rpm 3/60/220 Elec. Start.
2— 45 KVA Chry. New 6 Cyl. 3/60/220/440.
1—200 KW G.M. Twin 6-71, 240 D.C. Rad. Cooled Elec. Start.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1500	Al. Ch.	sl. rg.	2300	514
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CS	2300	1800
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
2	200	G.E.	KT559	2200	1200
1	200	West.	CW	440	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	KT352	220/440	1200
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

EXCEPTIONAL DELIVERY
New O'Brien mfrd. Red Line dry type Transformers to 150 KVA single phase, 300 KVA, 3 phase—4800 V. Pri.—& Phase Changers to 100 KVA.

TURBO GENERATORS
Philadelphia Stock

1—2500 KVA West. Cond. New 1936. 3/60/2400—200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—1000 CFM Chicago OCE Syn. Mtr. Dr. 175 HP 3/60/2300.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—215 CFM Penna 3A, 70 psi—V-Belt.
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7⅛x6x4, 100 psi
2—22 CFM Curtis 3 Stg. 1500 psi; V-belt

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
2	1000	West.	33000	460	3
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	150	West.	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.
3—333 KVA New O'Brien Red Line O.I.S.C. Transformers 4160 V primary 480 V secondary ea. single ph. 60 cyc.

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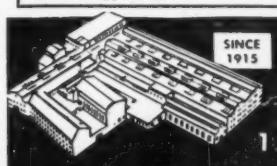

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SQUIRREL CAGE MOTORS
(3 Phase, 60 Cycles)

Qu.	HP	Make	Speed	Type	Voltage
2	350	Burke	3570	EF-729,TEFC	440
2	350	G. E.	710	K	2300
1	200	G. E.	600	IK	220/440
1	150	Fynn W.	720	35V-RN	440
1	150	G. E.	1200	IK-15	440
1	135	G. E.	720	MT563	440
1	125	A. C.	720	Open	440
1	100	G. E.	3600	I-17	440
3	100	A. C.	1200	AR	440
1	100	G. E.	900	IK	220
1	100	G. E.	900	I	440
2	100	Reliance	870	AA	2300

SLIP RING MOTORS (3 Phase, 60 Cycles)

4new	3500	G. E.	120	IM	2300
1	500	G. E.	720	MT	2300
1	200	Ideal	1200	AV-Vert.	4000
1	200	Whse.	600	CW	220
1	200	G. E.	600	IM	220/440
1	200	G. E.	380	I	440
1	150	Whse.	1200	HF	2200/4000
1	150	Whse.	870	C-I with brake	440
2	100	A. C.	390	ANY	440

DC MOTORS

1	750	G. E.	600	MCF, Ped. Bear.	550
1	350	G. E.	450	MPC, 3 Bear.	230
1	275	G. E.	450	MPC, 3 Bear.	230
1	150	W. E.	1635	RC	230
1	150	Diehl	250/400	Shunt, 3 Bear.	230
1	100	Reliance	500	Open	230
1	75/40	Whse.	330/900	SK191	230

AC GENERATORS

Qu.	KV Rating	Make	Speed	Type	Output
1	300	F-M	257		3-60-480
2	31½	Whse.	1200	Open	3-60-120/208
1	31	F-M	1800	TG	3-60-240

DC GENERATORS

1	325	G. E.	500	MPC, 3 Bear.	250
1	250	G. E.	500	MPC, 3 Bear.	250
1	100	G. E.	675	DLC	250
1	65	Whse.	1175	SK	120
1	40	Reliance	1150	Dr. Pr.	250

DC M-G SETS

Qu.	KW Rate	Make	Speed	Type	AC Drive Volt.	AC Drive HP
1	700	G. E.	720	MCF	550	500
1	200	A-C	850	Compound	250	300
1	75	G. E.	1150	RMC-15	75/75	100
1	40	G. E.	1160	MPC	125	75
1	40	G. E.	1175	CD-129	125	60
1	35	G. E.	1160	RC-35	120	50
1	30	Whse.	1470	SK	115	50
1	25	F-M	1800	DG	125	40
1	15	F-M	1800	CPB	120	25

BLOWERS

3—57000 to 26000 CFM, 5" to 12" SP, 100 HP, 1800 RPM, 3-60-220/440, size NO55, 2 stage, axial flow, International Eng.
2—12000 CFM, 16" SP, 75 HP, 1800 RPM, 3-60-220/440, A-C, turbo type.

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ALL BALL BEARINGS

SPECIAL OFFERING

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All Motors in Original Crates

230 VOLT

Amt	Hp	Speed	Make	Type	Frame	Winding
2	40	1140	Star	2CA0545-3		Sh
3	30	1750	GE	CDM	85	Sh
1	30	1750	GE	CD TEFC	95	Sh
3	30	1750	Westgh	SK	93	Sh
1	30	1150	Cent			Sh
1	30	850	GE	CDM	1126	Comp
2	25	1750	Westgh	SK	103	Sh
1	25	1750	GE			Sh
8	20	2590/3450	L.A.	OGNA	3261	Sh
2	20	2590/3450	N'wstn	CD	75	Sh
1	15	1500	GE	CDM	83	Sh
1	10	1750	Cent	DN	324	Sh
1	10	1225/1750	Westgh	SK	63	Sh
1	10	1750	GE	CDM	66	Sh
1	10	850	GE	CDM	75	Series Dbl end
2	7½	1750	Rel		23T	Sh
5	7½	1750	F & M	DZS	LA284	Sh
4	7½	1750	GE	SK	284	Sh
1	7½	1750	L. A.	NA		
5	7½	1750	Westgh	SK	43	Sh
11	7½	1150	Imp	D	D26	Sh
2	7½	1150	GE	CDM	66	Comp
9	7½	850	GE	CD	75	Sh
1	2½ to 5 KW	575/1150	E. Dyn		D326	Sh
1	5	1700	Rel	23T		Sh
1	5	1250	GE	B	254	Sh
2	5	1150	GE	B	284	Sh
2	5	850	GE	CDM	66	Sh
22	5	850	Imp	D	D242	Comp
2	3	1850	Westgh	SK	284	Sh
3	3	1750	Cent	DN	225	Sh
1	3	1750	GE	B	225	Sh
1	3	1750	Kimble	BA	225	Comp
1	3	1750	Star	2C00-2250		Sh
2	3	1150	F & M	DZ D	LB254	Sh
2	3	850	GE	B	284	Comp
5	3	850	GE	B	284	Sh
1	3	850	E. Dyn		D284	Sh
12	2	1750	Rel		225	Sh
6	2	1150	GE	B	225	Sh
1	2	1150	Westgh	SK	254	Sh
12	2	850	GE	B	254	Sh
1	1½	850/1750	Westgh	SK	254	Sh
12	1½	1200	GE	B	224	Sh
24	1½	850	GE	B	254	Sh
3	1	1150	GE	B	204	Sh
4	1	850	GE	B	225	Sh

115 VOLT

Amt	Hp	Speed	Make	Type	Frame	Winding
2	40	1750	GE	CDM	93	Sh
1	30	1140	Star	2CAE-516		Sh
1	30	850	GE	CDM	AA	Comp
1	10	1750	Cent	DN	332	Comp
11	10	1750	GE	CDM	66	Comp
5	GE, 10 HP, Magnetic Controls W/spare armature for above motor					
1	7½	1750	L.A.	GNA	284	Sh
2	7½	1750	N'west	4E4½		Comp
1	7½	1750	Crock	WH CCM		Comp
8	5	1150	GE	B	284	Comp
24	2	1750		HI		Comp
4	2	1750	Westgh	SK	225	Comp
3	2	1750	B-Line	DM	225	
2	1	3450	GE	BC	76A	Comp
1	1	1150	GE	B	204	Comp
5	1	850	GE	B	225	Comp
9	¾	1725	GE	B	764	Comp
45	½	1725		H	186	Comp
2	½	1725	F.&M.	BD	65X	Comp
65	½	1725	GE	BC	74A	Comp
5	⅓	1725	GE	BC		Comp
13	⅓	1140	Wag	TD	57V	Comp

GEARMOTORS, 115 VOLT

37 Star Gearmotor, 7½ HP, 1750 RPM, type 5G-284-5-6, compound, 30 minute duty, W/GE, Model B284B156, ratio 11.5 to 1.

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complete with controls, etc.

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200# W.P. condensing—3-60-2300-3600
with exciter, condenser

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100 HP Westinghouse 3-60-2200-1200
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250 HP G.E. 3-60-220-1800
100 HP West. 3-60-2300-1800
100 HP Elec. Mchy. 3-60-440-1200

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700	Al.Ch.	480	700
1250	Al.Ch.	480	900
250	C.W.	250	1200

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4—500	WH.	600	1200

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3	50	Century	SC-405	S. B. drip proof
2	50	Ideal	A-405	S. B. open
4	60	Ideal	AH-444	S. B. open
2	60	L. A.	OGA-444	S. B. drip proof

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1—25 HP West. CS-365 1760
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1—25 HP G.E. K404 1170
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1—3000 AMP. Westinghouse 2 Pole

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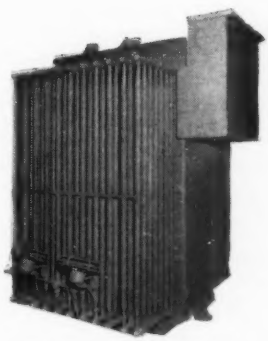
3— 500 KVA 38100/66000Y—2300 v.
3— 500 KVA 33000 v.—2300 v.
4— 500 KVA 13200 v.—2300 v.
4— 200 KVA 33000 v.—2300/4160Y
5— 200 KVA 13200—2300/4160Y
1— 200 KVA 12000—2300/4160Y
3— 200 KVA 7620/13200Y—2300
1— 150 KVA 66000—2300/4160Y
14— 100 KVA 33000—2300/4160Y
9— 100 KVA 13200—2300/4160Y
6— 100 KVA 7620/13200Y—2300/4160Y
3— 75 KVA 460—120/240
3— 75 KVA 2400—230/460
2— 50 KVA 60000—2300 v.
1— 50 KVA 6600/11400Y—2300
3— 50 KVA 13200Y—2300 v.
1— 25 KVA 13200Y—240/480
1— 25 KVA 7200/12470Y—240/480
3— 25 KVA 400/4160Y—120/240
3— 25 KVA 2400—230/460

8—15 KVA 67—5 KVA
62—10 KVA 26—3 KVA
71—7½ KVA 15—1½ KVA



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FAST SHIPMENT FROM STOCK

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2—110000/66000-110 v. 200 VA West. P.T.
3—34500-115 V. 200 V.A. West. P.T.
9—33000-110 V. 200 VA GE P.T.
2—60/120—5 A. 37 KV G.E. C.T.

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BOILERS

1—900 HP Springfield sectional header boiler, 400# W. P., 1926, A.S.M.E., Oil Burner equipment, deaerating heater, feed pumps. New Mexico.
2—824 HP Sterling Boilers, 1930, active certificate for 300# W. P. chain grate stokers, ELESCO superheaters, all auxiliaries, Austin, Minn.
2—750 HP, B. and W. Sterling type boilers, 225# W. P., 1925, A.S.M.E., oil firing equipment, all auxiliaries, New Mexico.
3—600 HP, B. and W. longitudinal drum, sectional header boilers, 1922, A.S.M.E. 225# W. P. Peabody oil burners, steel headers, New Jersey.
2—500 HP, B. and W. Boilers, 1916, retubed 1925, 209# W. P. Lawrence, Mass.
1—490# Walsh-Widener Cross Drum, Sectional Headers, 4" tubes, 1927, 450# W. P. all auxiliaries. West Point, Virginia.
1—400 HP Keeler C. P. Boiler, 1942, 160# W. P. new tubes and refractory, TODD mechanical oil burner and pump set. Overhauled, dismantled. Ready to ship. N. Y.
Complete plant consisting of:
2—20,000# pr. hr., 160# W. P., 1942, B. and W. steam generators, deaerating heater, all boiler auxiliaries. A complete plant. San Fernandino, Florida.
2—400 HP, B. and W. sectional header boilers, 200# W.P., steel headers, A.S.M.E., 1921, South Bend, Indiana.
1—310 HP Keeler C. P. Boiler, 160# W. P. 1942, pressure parts ship in one piece. Lake City, Florida.
1—300 HP Keeler C. P. Boiler, 160# W. P., 1942, all auxiliaries. Milton, Pa.

PACKAGE BOILERS

1—400 HP CLEAVER-BROOKS, 150# W. P., 1949, fully automatic, No. 6 oil. N. J.
2—350 HP Preferred Utilities Steam Generators, 200# W.P., 1948, fully automatic, No. 6 oil, Washington, D. C.
Miscellaneous Scotch Marine Boilers, 75 to 150 H.P. available.
A number of Self-Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.
2—Detroit Roto-Spreader Stokers for 300 H.P. Boilers, nominal rating.
Combustion Engrg., Spreader Stoker complete with fan & Hogan Controls-Stoker. Designed for 600 H.P. boiler at 200% of rating, or 1200 H.P.
3—Elliot Surface Condensers, 1—900 sq. ft. 2—600 sq. ft. Located in New Jersey.
1—500 KW G.E. Turbine, 5 Stage with 625 KVA Alternator, 440 V., 600 sq. ft. Elliot super condenser.
1—300 K.W. Gen. Elec. Turbo-generator set. Completely rebuilt and rewound for 220/440 V. includes switchboard and exciter. Presently boxed for export. Offered at an extremely low price.
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1—2000 KVA, 3-60-33000-4160Y Westinghouse type CPS self-contained substations.
1—450 KVA, 3-60-13200-115/230 V. G.E. substation.
6—Section NEW G.E. switchboard consisting 2000, 600 and 350 A. drawout air breakers.
700 & 450 HP, 180 rpm, 4160V-3-60 UNUSED Syn motors.
1—37½ KVA-240/480 V.-3-60 Cat. Diesel set.

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42 diesel engines from 60 to 800 h.p., more than 100 motors and generators complete with controls, twenty-four 250 h.p. Babcock & Wilcox boilers, and many other items. For the best bargains you ever saw, write for a list to:

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6—	1000 KVA Mol	11500—2400/4160Y
3—	500 KVA G-E	22000—2300/4000Y
3—	333 KVA G-E	33000—2300/6900
3—	333 KVA G-E	33000—2300/4000Y
3—	333 KVA Mol	7200/12470Y—2400/4160Y
3—	333 KVA W-H	6600—2300
3—	200 KVA G-E	2400/4160Y—120/240
1—	200 KVA Mol	2400/4160Y—240/480
3—	150 KVA G-E	44000—600/2400
3—	150 KVA G-E	19050/33000Y—2540/4400Y
3—	100 KVA G-E	33000—6900/11950Y
3—	50 KVA A-Ch	33000—2400/4160Y
1—	500 KVA W-H	27600—444/131 3-ph.
1—	450 KVA Penn	14520/13200—2400 3-ph.
1—	150 KVA G-E	7620/13200Y—120/208Y 3-ph.

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Reliable rewind and repair service on all makes of transformers

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G.E. 150 K.W., M.G. SET
1200 R.P.M. Synchronous A.C. 3-60-220, D.C.—125 Volt. With A.C. and D.C. Panels.
Condition excellent
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SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	440	Whse.	1800
600	2200	Whse.	450
500	440/220	Whse.	720
500	2200/4000	G. E.	900
450	440	Whse.	514
350	4000/2300	Whse.	1800
300	2200/440	G. E.	720
300	440	G. E. (hoist)	600
300	2200/440	Whse. (new)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
250	440	G. E.	600
200	440/220	Whse.	514
200	440	G. E.	450
150 (2)	440/220	G. E.	720
150	2200/440	G. E.	600
150	550/220	G. E.	720
145	4000/2300	G. E.	1800
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
350	440/220	El. Mchy.	Syn.	1200
350	440/220	Whse.	HR	900
300	2300/400	G. E.	TS	720
300	2300/440	G. E.	TS	720
250	440/220	Whse.	HR	277
250	2200/440	G. E.	TS	1200
250	440/220	G. E.	ATI	600
240	2300/440	G. E.	ATI	720
225	440/220	Whse.	HR	360
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
120	440/220	G. E.	ATI	900
110	440/220	G. E.	TS	257

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200	Whse.	CS	514
500	2200/4000	Elliot	SC	1800
400	2200/400	Whse.	CS	720
300	2200	L. Allis	FS	1800
300	2200	G. E.	FT	3600
250	2200/440	G. E.	IK	720
225 (2)	2200/440	G. E.	KT	1200
200	2200/440	G. E.	K	1200
200	440	G. E.	IK	720
200	440	G. E.	IK	514
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	440/220	Howell	B. Brg.	1800
150	440/2200	G. E.	IK	514
150	2200/440	G. E.	KT	600
125	440/220	G. E.	KT (vert.)	1200
100	2200/440	G. E.	K	1200
100	220/440	G. E.	K-TEFC	720
60 (2)	2200	Whse.	CS X-pf.	1800
50 (2)	410/220	Whse.	CS-TEFC	1800
50	220	Al. Chal.	X-prf.	600/1200

A. C. GENERATORS

1—320 kva. 660 rpm 2300/440/220 V., G.E.
1—250—kva. 720 rpm. 2300/440 V., G. E.
1—225 kva. 600 rpm. 220/440 V. G. E.
1—200 kva. 720 rpm. 2200/440 V., G. E. (Ball brg.)
1—187 kva. 1200 rpm. 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V
6—FKR-155-28, 600 amp., 15,000 V., G.E., Sol. oper., draw-out.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
250	230 (2)	G. E.	CD	1750
150	230	Whse.	SK	850
100	230	Cr. Wh.	CMC	625
90	230	G. E.	CD	1750
80	230	G. E.	RC	600
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
150	Whse.	440	sq. ca.	250
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250
65	G. E.	2200/440	sq. ca.	125
60	G. E.	440/220	sq. ca.	250/125
45	G. E.	440/220	sq. ca.	250
40	G. E.	440/220	sq. ca.	250/125

TRANSFORMERS 60 Cy.

1—600 kva. Standard, 13,800-2300 V., 3 ph.
3—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—480/240 V.
3—150 kva, G. E., 33000—2300/4600 V.
3—150 kva, Al. Chal., 2400—240/480 V.
3—150 kva, Al. Chal., 2400—240/120 V.
3—100 kva, Whse. 2400—240/480 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G. E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3— 50 kva, Whse. 440—220/110 V.
6— 50 kva, G. E., 2400—120/240 V.
11— 50 kva, Whse., 2300-110/220 V., dry

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LAND'S 44th YEAR
MOTORS & GENERATORS, etc.
1 YEAR GUARANTEE

125 VOLT DC GENERATORS

KW	Make	Speed
200	West.	900
150	Westg. (2)	1200
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
60	Westg.	1750
50	Cr. Wh.	1160
50	G. E.	1150
50	Westg. (2)	1150
40	G. E. 3-unit	1150

PLUS 40 additional units
½ to 40 KW

250 VOLT DC GENERATORS

KW	Make	Speed
2000	G. E.	NEW
1150	G. E.	NEW
750	G. E. (2)	NEW
400	G. E.	NEW
250	Cr. Wh.	1200
200	G. E.	1200
150	Westg.	900
125	G. E. (2)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150
60	N. W.	1150
40	Rel.	1750
40	G. E. 3-Unit	1150
25	G. E.	1200
17	A-C	1750
15	Star	1750
10	G. E.	1150

PLUS 15 additional units
½ KW to 7½ KW

SLIPRING MOTORS

HP	Make	Speed
600	C. W.	514
500	G. E.	600
500	G. E. (2)	450
450	G. E. (2)	880
350	Westg.	435
300	Westg.	1150
250	G. E.	600
200	G. E.	1750
200	Westg.	600

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General Electric, Louis Allis, Reliance, Westinghouse. NEMA FRAME
Discounts from 60% to 65% Off on Motors listed below.

25 CYCLE TEFC & EXPLOSION-PROOF
(2G Label) 220-440 volts

Amt.	HP	Speed	Make	Frame
1	30	1500	Rel.	445
1	25	1500	Rel.	405
1	15	1500	L.A.	405S
1	15	1500	G.E. (open)	404
3	10	1500	L.A.	364
3	5	1500	L.A.	284
1	3	1500	L.A. I-D	284

1/60/115-230 (1-D Label)

3	3	1800	L.A.	254
1	1½	1800	L.A.	225
1	1½	1200	G.E.	225
6	1	1800	L.A.	224

1/60/115/230 OPEN DRIP-PROOF

26	1	1800	L.A.	204
7	1	1800	Std. D.	203

2/60/220-440 OPEN DRIP-PROOF

1	7½	900	L.A.	326
2	5	1200	L.A.	284
1	1½	1200	L.A. (Splash)	224
4	1	3600	L.A.	163
2	1	1800	L.A.	203

3/60/550—OPEN DRIP-PROOF

1	100	3600	G.E.	445S
13	40	3600	Rel.	404S
1	25	3600	G.E.	364S
4	5	3600	L.A. XP	225

NEW MOTOR STARTERS

6—Size 3 Allen-Bradley, XP-2G Label Bul. 709
1—Size 3 Whse. Combination, Circuit breaker, Nema 1, 3/60/440
21—Size 2 G.E. combination fusible, 60 & 100 amp, 3/60/220
98—Size 1 NEW Whse. life line 3/60/220

3/60/220 GEARMOTORS

3—10 HP, 55 RPM, Whse. FR. 324, Parallel Shaft Output
17—NEW Cleveland right angle worm gear reducers rated 5 HP—1150 RPM, 7.5 HP—1750 RPM, 6-1 Ratio, Series 215—50 RT Class 1
4—Ratio 10-1; series 25F—ditto

230 V DC

1	10	1200	Whse.	SK63
4	7½	1200	Elec. Dy.	324

10,000 Other Motors in Stock
FHP Thru 1000 HP, New and Rebuilt

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● HYDRAULIC COUPLINGS ●

Stepless speed variation with constant speed prime mover made by American Blower Co. Ideal for pumping stations, steel mill drives, mechanical draft fans, crushers, rotary kilns, etc.
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ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Aerotec Corp. *
Air Preheater Corp. 165
Allen-Sherman-Hoff Co. Second Cover
Allis-Chalmers Mfg. Co. 4, 18-19, 32, 39, 67, 153, 166, 176, 177
Allis-Chalmers Mfg. Co. (Tractor Div.) 44-45
Allpax Company 250
Aluminum Co. of America 314
American Blower Co. 33-34
American Brake Shoe Co. (Brake Shoe & Casting Div.) 258
American Chain & Cable Co. 202
American Chimney Co. 312
American District Steam Co. 308
American Engineering Co. 294
American Gilsonite Co. 301
American Locomotive Co. (Alco Products Div.) 68-69
American Pulverizer Co. 272
Ames Iron Works, Inc. *
Anchor Packing Co. 227
Anderson Co., V. D. *
Arkansas Fuel Oil Co. 213
Armstrong Machine Works 143

Babbitt Steam Specialty Co. 266
Babcock & Wilcox Co. 6-7
Badger Mfg. Co. 268
Bailey Meter Co. 12-13
Baldwin-Hill Co. *
Baltimore & Ohio Railroad 157
Beaumont Birch Co. *
Belco Industrial Equip. Div. Inc. *
Bell & Gossett Co. 302
Belmont Packing & Rubber Co. 216
Bendix Aviation Corp. (Fries Instrument Div.) *
Bethlehem Steel Co. 284
Betz Co., W. H. & L. D. 141
Biddle Co., James G. *
Bigelow Company *
Bituminous Coal Institute 183
Black, Sivalls & Bryson Inc. *
Blaw-Knox Co. *
Boiler Tube of America 222
Bonney Forge & Tool Works *
Botfield Refractories Co. *
Bros Boiler & Mfg. Co., Wm. 287
Brown Boveri Corp. 30-31
Buell Engineering Co. 264
Buffalo Forge Co. 191
Buffalo Pumps, Inc. 70
Builders-Providence, Inc. 304
Burgess-Manning Co. 236
Bussmann Mfg. Co. 72-73
Byers Co., A. M. 74

Canton Stoker Corp. *
Carey Mfg. Co., Philip *
Cash Co., A. W. 283
Catawissa Valve & Fittings Co. *
Chapman Valve Mfg. Co. 175
Chase Brass & Copper Co. *
Chesterton Co., A. W. 110
Chicago Pneumatic Tool Co. 54
Childers Mfg. Co. *
Cities Service Oil Co. 213
Clapp & Poliak 230
Clarage Fan Co. 285
Clark Mfg. Co. 229
Cleaver-Brooks Co. (Boiler Div.) 271
Cochrane Corp. 269
Combustion Control Corp. 172-173, 174
Combustion Engineering Co. *
Cooper-Bessemer Corp. *
Copes-Vulcan Div. Continental Foundry & Mach. Co. 14-15, 16-17
Crane Co. 56, 159
Crane Packing Co. 232
Cyclotherm Corp. *

Darling Valve & Mfg. Co. 278
Dart Union Co. *
Davis Regulator Co. 262
Dean Hill Pump Co. *
Dearborn Chemical Co. 62-63, 314
De Laval Separator Co. 195
De Laval Steam Turbine Co. 2
Deming Co. *
Detroit Stoker Co. 259
Diamond Power Specialty Corp. 10-11
Dodge Mfg. Corp. *
Dow Corning Corp. *
Dowell, Inc. 171
Dravo Corporation 66, 296
Drew & Co., E. F. 241
du Pont de Nemours & Co., Inc. (Polychemicals Dept.) 275

Eagle-Picher Co. *
Eastern Gas & Fuel Associates 249
Edward Valves, Inc. 46-47
Electric Machinery Mfg. Co. *
Elgin-Refinite, Inc., Div. of Elgin Softener Corp. *
Elliott Company 8-9, 219
Elliott Co. (Lagonda Div.) *
Engineer Company 214
Erico Products, Inc. 299
Erie City Iron Works *
Ernst Water Column & Gage Co. 312
Everlasting Valve Co. 212

Fisher Governor Co. 225
Flexitallic Gasket Co. *
Flexonics Corp. 273
Fluor Corp., Ltd. *
Forty-Eight Insulations, Inc. *
Foster Engineering Co. *
Foster Wheeler Corp. 58-59
Foxboro Company *
Frick Company 310
Fuller Company 298

Garlock Packing Co. 190
General Cable Corp. *
General Electric Co. (Apparatus Dept.) 26-27, 52-53, 57, 188-189, 210-211
General Refractories Co. 279
Globe Steel Tubes Co. *
Golden Anderson Valve Spec. Co. *
Goodrich Co., B. F. 35-36-37-38
Goulds Pumps, Inc. 184
Graver Water Conditioning Co. 161
Green Fire Brick Co., A. P. *
Green Fuel Economizer Co. 220
Greene, Tweed & Co. 304
Grinnell Company Third Cover
Griscom-Russell Co. 305
Gruendler Crusher & Pulverizer 308
Gundlach Machine Co., T. J. 246
Gustin-Bacon Mfg. Co. *

Hagan Corporation 206-207
Hall Laboratories 179
Hammel-Dahl Co. 217
Harbison-Walker Refractories Co. 64-65
Hardie Clamp Scaffolding 312
Haynes Products Co. 312
Hays Corporation 334
Hendrick Mfg. Co. *
Henszey Company *
Hewitt-Robins, Inc. 60-61
Hevl & Patterson, Inc. *
Hill Pump Valve Co. *
Hilliard Corporation *
Hills-McCanna Co. *
Hoffman Combustion Engrg. Co. *
Hoffman Specialty Mfg. Corp. *

Illinois Water Treatment Co. *
Infilco Inc. 254
Ingersoll-Rand Co. 243
International Nickel Co. 313
Iron Fireman Mfg. Co. 42-43
I-T-E Circuit Breaker Co. 196-197

Jeffrey Mfg. Co. 40-41
Jenkins Bros. 148-149
Jerguson Gage & Valve Co. *
Johns-Manville 155
Johnson Service Co. *
Johnston Pump Co. *
Joy Mfg. Co. 255

Keasbey & Mattison Co. 276
Kellogg Co., M. W. *
Kennedy-VanSaun Mfg. & Engrg. Corp. *
Kewanee-Ross Corp. 293
Key Company *
Klipfel Valves Inc. 306
Klöckner-Humboldt-Deutz, A. G. Köln, R. H., Germany 306
Koppers Co., Inc. (Coupling Dept.) *
Kuljian Corporation *

Ladish Company *
Leeds & Northrup Co. *
Leslie Company 261
Link-Belt Company 1
Lockett & Co., Ltd., A. M. *
Lonergan Co., J. E. 240
Lubriplate Div. Fiske Bros. Refining Co. 234
Lummus Company Western Piping Supply Div. 308
Lunkenheimer Company 265

Manning, Maxwell & Moore, Inc. 274
Marley Company 245
Marsh Heating Equipment Co. *
Mason-Neilan Regulator Co. *
McAlear Mfg. Co. 221
McGraw-Hill Book Co. 234
McKiernan-Terry Corp. *
Mercoid Corporation 306
Midwest Piping Co., Inc. 263

Industrial Div.
Minneapolis-Honeywell Reg. Co. 28-29
Mundet Cork Co. ..... *
Murray Co., Inc., A. B. ..... *
Murray Mfg. Co., D. J. 262
Murray Iron Works 248

National Airoil Burner Co., Inc. 228
National Aluminate Corp. 147, 182
National Conveyor & Supply Co. 226
National Conveyors Co., Inc. ..... *
National Tube Co. 307
National Valve & Mfg. Co. 288
Niagara Blower Co. 260
Nicholson & Co., W. H. 230
Nordberg Mfg. Co. 216, 286
Norton Company 292

Oakite Product, Inc. 226
Ohio Injector Co. 235
Orr & Sembower Inc. 295

Panalarm Products, Inc. ..... *
Panellit, Inc. 251
Pangborn Corporation ..... *
Parker Appliance Co. ..... *
Peabody Engineering Co. 257
Peerless Pump Div.
(Food Machy. & Chemical Corp.) 309
Penberthy Injector Co. 270
Pennsylvania Flexible Metallic
Tubing Co., Inc. 303
Pennsylvania Pump & Compressor Co. ..... *
Permutit Company ..... *
Perolin Company ..... *
Petro 293
Philadelphia Gear Works 247
Pipe Fabrication Inst'tute 205
Pittsburgh Piping & Equipment Co. 280
Powell Co., Wm. 192-193
Power 266-267
Powers Regulator Co. 55, 133
Pritchard & Co., J. F. ..... *
Pure Oil Co. ..... *
Pyle-National Co. 246

Radio Corp. of America ..... *
Ranney Method Water Supplies, Inc. ..... *
Ray Oil Burner Co. ..... *
Raybestos-Manhattan Inc.
Manhattan Rubber Div. 291
Reading, Pratt & Cady Div. 202
Republic Flow Meters Co. 20-21
Republic Mfg. Co. ..... *
Republic Steel Corp. ..... *
Research Corporation ..... *
Revere Copper & Brass, Inc. ..... *
Ric-Wil Company 310
Ridge Tool Co. 178, 244
Riley Stoker Corp. 108-109
Rohm & Haas Co.
(Resinous Prod. Div.) ..... *
Roto Div. of Elliott Co. 242

Sarco Company 145
Schaub Engrg. Co., Fred H. 297
Schramm, Inc. ..... *
Scully Signal Co. 240
Sea-Ro Packing Co., Inc. ..... *
Shell Oil Co. 223
Simplex Valve & Meter Co. 250
Sims Pump Valve Co., Inc. ..... *
Sinclair Refining Co. ..... *
Skinner Engine Co. 208
Smith Corp., A. O. ..... *
Socony-Vacuum Oil Co., Inc. ..... *
Spence Engineering Co. 204
Squires Co., C. E. 311
Standard Oil Co. of Indiana 187
Steamaster Automatic Boiler Co. 310
Steel & Tubes Div. ..... *
Stephens-Adamson Mfg. Co. 231
Stickle Steam Specialties Co. ..... *
Stock Equipment Co. 239
Stone & Webster Engrg. Co. 203
Strong, Carlisle & Hammond Co. ..... *
Struthers Wells Corp.
(Titusville Iron Works Div.) 222
Sun Oil Company 139
Superior Combustion Industries 51, 169
Swartwout Company 163

Taylor Instrument Co's. 300
Taylor & Co., W. A. 266
Tennessee Corporation ..... *
Terry Steam Turbine Co. 277
Texas Company ..... *
Thermix Corp. ..... *
Thompson Products, Inc. ..... *
Tidewater Associated Oil Co. 199
Todd Shipyards Corp.
(Combustion Equip. Div.) ..... *
Platecoil Div. of
Tranter Mfg. inc 218
Tube Turns Inc. 185-186

Union Asbestos & Rubber Co. 289
United Cooling Tower Co. ..... *
U. S. Electrical Motors, Inc. 237-238
United States Gasket Co. 256
United States Gauge
(Div. of Amer. Mach. & Metals Inc.) 290
United States Rubber Co.
(Electrical Wire & Cable Dept.) 209
United States Rubber Co.
(Mechanical Goods Div.) ..... *
U. S. Steel Corp. 307

Van Der Horst Corp. 253
Vernon Tool Co., Ltd. ..... *
Viking Pump Co. ..... *
Vogt Machine Co., Henry 281

Wallace & Tiernan Co., Inc. 198
Walworth Company ..... Back Cover
Warren Steam Pump Co. ..... *
Water Cooling Equipment Co. 224
Watson-Stillman
(Fittings Div. H. K. Porter Co.) 215
Western Chemical Co. ..... *
Western Precipitation Corp. 282
Westinghouse Electric Corp. 180-181
Westinghouse Electric Corp.
(Sturtevant Div.) 151
Where to Buy 312
Wickes Boiler Co. 233
Wiedeke Co., Gustav ..... *
Wing Mfg. Co., L. J. 194
Winslow Engineering Co. ..... *
Worthington Corp. 22-23, 48-49, 50, 200-201
Wright-Austin Co. 252

Yarnall-Waring Co. 24-25, 135

Zallea Bros. ..... *
Zimmerman Packing Co. ..... *

Professional Services **312**

SEARCHLIGHT SECTION

(Classified Advertising)

H. E. Hilty, Mgr.

EMPLOYMENT
Positions Vacant 315
Selling Opportunities Offered 315
Positions Wanted 315, 316
Selling Opportunities Wanted 316

EDUCATIONAL 316

NOTICES
Legal 316

EQUIPMENT
(Used or Surplus New)
For Sale 316-331

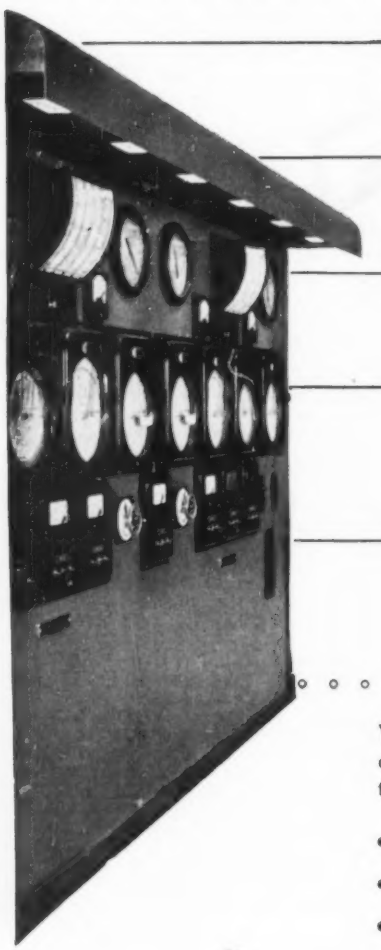
WANTED
Equipment 316

ADVERTISERS INDEX
Alion Electric Diesel Co. 320
Allied Electric Co. 316
American Air Compressor Corp. 325
American Electric Service & Maintenance
Co. 326
Arizona Public Service Co. 315
Baker, Leon J. 325
Belyea Co., Inc. 318
Benson-Wilimzig Inc. 331
Boston Metals Co., Inc. 322
Brew-Woltman & Co., Inc. 318
Brotan Realty Corp. 316
Brown, Hugh A. 331
Buckeye Trading 328
Chicago Electric Co. 319
Continental Iron & Metal Co. 323
DeRose, G. M. 323
Diamond Electric Co. 316
Ebasco Services Inc. 330
Electric Equipment Co. 325
Electric Service Co. 330
Electrical Products Sales Corp. 326
Ellis Co., A. Lee 326
Erie Electric Co., Inc. 329
George School, Pa. 325
Glosser & Sons, Inc., M. 327
Gordon Steel Products Inc., Dave 330
Hall & Co., Stephen 331
Harris Machinery Co. 328
Heller Co., Albert 326
Hemphill & Co., J. L. 324
H & P Machinery 321
Howe Brothers 325
International Power Machinery Co. 323
Johnson & Assoc., H. Blaine 330
Juilliard & Co., Inc., A. D. 324
Keck Electric Corp. 327
Land, L. J. 331
Lestan Corp. 320
MacCabe Co., T. B. 326
McDonald, Claude T. 316
Midwest Utilities Power Equipment Co. 328
Mississippi Valley Equipment Co. 321
National Electric Service Co. 320
Newman & Co., Inc. 323
O'Brien Machinery Co. 327
Ohio Valley General Hospital 330
Porter, Arthur G. 325
Power Equipment Co. 322, 328
Power Plant Equipment Co., Inc. 321
Rearick, Charles B. 328
Schoonmaker Co., Inc., A. G.
320, 321, 326, 331
Sherb, Warner J. 330
Smith Co., H. Y. 328
Strickler & Assoc., Dean C. 327
Summer & Co. 330
Tampa Armature Works Inc. 329
Tennessee Valley Authority 316
Utility Equipment & Construction Co. 316
Wagner Co., Arthur 322
Walker & Collins 316
Weaver, Charles 317
Wholesale Electric Motor Co. 328

what *results*

do you want from your

COMBUSTION CONTROL SYSTEM ?



Low maintenance?

"We find that due to the (Hays) properly controlled combustion, our maintenance on both stokers and boilers has been considerably decreased."

American Tobacco Company

Good CO_2?

"CO_2 readings show that on an average day our CO_2 varies between 13% and 14% despite load fluctuations."

Sunshine Biscuits, Inc.

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"Operating efficiency has been as high as 82%—much of the credit going to the accuracy of (Hays) automatically controlled combustion."

Sherwin Williams, Chicago Plant

Fuel savings?

"We estimated that . . . we would be able to pay for the new equipment (Hays Combustion Control) out of fuel savings in three years. Since then, the records show that the amortization of the original investment has been accelerated."

Raybestos—Manhattan, Inc.

Rapid response to wide load swings?

"We have made test runs using the Hays system, bringing the load rapidly up from 8,000 to 80,000 lbs per hour with excellent results. Fuel-air ratio was held at the desired value and CO_2 at 15%."

Bemis Brothers Bag Company

You want the *specific results to solve your combustion problems.* Hays engineers have the experience to give you results like:—

- **smoke abatement**
- **reduced labor costs**
- **decreased outage**
- **constant steam pressure**
- **lower fuel bills by switching fuels**
- **firing mixed fuels efficiently**
- **rapid response to steam demand**

HOW TO GET *RESULTS*

Send a statement of your combustion problem and the results you want to Orval W. Riggs, Mgr., Application Engineering, The Hays Corporation, Michigan City 3, Ind. You will receive: 1. Our preliminary recommendations for a solution to *your* problem. 2. Hays' 48-page booklet on control systems and how they work. 3. Five "Case Histories", telling how leading companies got "results" on five different problems with

HAYS COMBUSTION CONTROL

THE **HAYS** CORPORATION *MICHIGAN CITY 3, INDIANA* • Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters • Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages • Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

Part of the welding floor at Grinnell's Warren, Ohio Plant

How shop fabrication of piping

keeps costs down...quality up!

When you specify piping fabricated in Grinnell shops, you are ALL to the good.

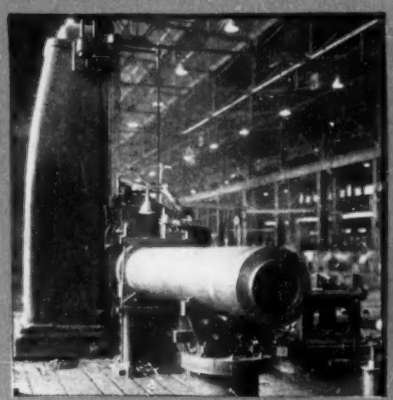
Here's why: — Included in the price (which is determined in advance) are such items of expense as:

- Interpretive engineering
- Shop sketches and planning
- Procurement of materials
- Heat, light, power, water, compressed air, expendable tools and supplies

But Grinnell even goes further. Grinnell finances material inventories and payrolls for you; carries insurance; makes no charges for waste material or spoilage.

On the production side, too, you benefit. Piping fabricated in Grinnell shops is done under ideal conditions, with modern equipment, by personnel qualified for each class of work. It is rigidly inspected and tested to meet customer's specifications and all applicable codes. Before shipment, it is cleaned inside and outside and painted. It is squared to dimensional tolerances, so that sub-assemblies can be erected at the job site quickly and easily.

You can count on it . . . Grinnell shop fabricated piping *guarantees* maximum quality and economy.



Heavy wall pipe being machined to the proper welding bevel on a post mill

Welding (induction heating coils in place for preheat, welding heat and stress relieving.)

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • **Coast-to-Coast Network of Branch Warehouses and Distributors**

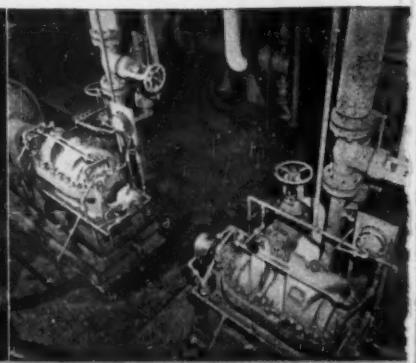
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

WALWORTH *Pressure Seal* VALVES

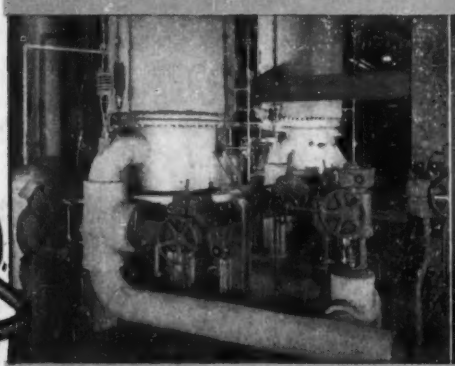
For high-pressure, high-temperature services

Walworth 6-inch Series 900 Pressure-Seal Gate Valve with Series 1500 Y-type Globe Valve on the by-pass.

CHEMICAL PLANT: Walworth Pressure-Seal Valves in the pressure reducing station of a chemical plant.



MARINE: Walworth Pressure-Seal Valves aboard the S.S. "Wilfred Sykes"—largest Great Lakes ore carri



LIGHT AND POWER: Walworth Pressure-Seal Valves equipped with motor operators, in an eastern public utility plant.

PAPER MILL: Fabricated header with 8-inch Ser 600 Pressure-Seal Y-Globe Non-Return Valves a Series 600 Pressure-Seal Gate Valve.

SMALL VALVES FOR HIGH PRESSURE-TEMPERATURE SERVICE

Series 1500 Cast Steel Y-type Globe and Angle Valves in sizes ¼ to 2 inches.

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. The bonnet joint of the Walworth Pressure-Seal Valve is permanently tight because there is no dependency on the ability of any component part of the joint to resist creep during long exposure to high temperature. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved flexible disc design maintains seat tightness, even when the valve body is distorted by pipeline stresses or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, 1500, 2500 and in a wide range of sizes and types. For further information, write for Circular 116.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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